2011 ECOSYSTEM SERVICES

Seminar Series

Measuring Nature's Balance Sheet

Catalyzing a community of practice that integrates nature's true value into workable solutions to achieve conservation outcomes

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Between March and November 2011, the Gordon and Betty Moore Foundation's (GBMF) Environmental Conservation Program assembled a small group of thought leaders and practitioners to increase awareness, facilitate the exchange of information, and generate vibrant conversation to transform ecosystem services (ES) theory into tangible actions.

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Background and History: Ecosystem Services

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Background and History: Ecosystem Services

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Healthy ecosystems provide a variety of critical services for society, from clean water to carbon sequestration to pollination (Daily 1997). We have long recognized specific "ecosystem services," and have both designed policies to protect them and used them to justify protecting and restoring the environment (Thompson 2008). For example, the United States created national forests in the late 19th century specifically to secure two ecosystem services that healthy forests provide: "favorable conditions of water supply," and a "continuous supply of timber" (Organic Administration Act of 1897).

Various cities, such as San Francisco and Seattle, have long protected their watersheds in order to ensure clean drinking water for their populations (Thompson 2000b, 295). However, while our environmental policies have long recognized the importance of specific ecosystem services, recent scientific scholarship has emphasized the pervasiveness and large economic importance of such services, documented their decline, and urged their use to animate and drive domestic and global environmental policy (e.g., Kareiva et al. 2011; Daily and Matson 2008; Millennium Ecosystem Assessment 2005; Costanza et al. 1997).

This paper provides an introduction to the ways in which this recent scholarship could improve environmental policy. As explained below, ecosystem services provide policy-makers and practitioners with a comprehensive framework for building on and enhancing, rather than replacing, traditional approaches to solving environmental challenges. Policy-makers and practitioners have long enjoyed a suite of tools for addressing environmental issues: prescriptive regulation, redefinition of property rights, market mechanisms and other financial incentives, direct governmental acquisition and management of environmental amenities, and social persuasion (Salzmann and Thompson 2010, 44–52). Looking at environmental challenges through the framework of ecosystem services can help justify the use of these tools in settings where the policy case today might be weak (e.g., by showing that the benefits of prescriptive regulation outweigh the societal costs). More important, the framework can help inform better use of the tools (e.g., by identifying those lands that would be most valuable to conserve) and showing new ways to use them (e.g., by creating new ecosystem-service markets).

This paper begins by providing a brief introduction to ecosystem services. In the section "Alternative Frameworks for Environmental Intervention," it turns to how the concept of ecosystem services fits within the standard justifications used for protecting and enhancing the environment. "Traditional Management Approaches" reviews the major tools traditionally used to manage the environment and considers how a better understanding of ecosystem services might improve such tools. Building on this background, "How Thinking in Terms of Ecosystem Services Might Help" then looks comprehensively at how ecosystem services might provide for better environmental management. "Potential Issues and Challenges" concludes with a discussion of several challenges to the use of an ecosystem-service framework in environmental policy and practice.

A BRIEF INTRODUCTION TO ECOSYSTEM SERVICES

Ecosystem services are the contributions that ecosystems make to human well-being — both goods, such as food and freshwater, and services, such as flood reduction and carbon sequestration. Because ecosystems contribute to the production of these goods and services in much the same way that human, financial, and manufactured capital produce other goods and services, the literature on ecosystem services sometimes refers to ecosystems as "natural capital." The terms "ecosystem services" and "natural capital" both refer to the fact that nature itself provides valuable goods and services to society, and that human well-being thus depends on the protection of nature, and the terms are often used interchangeably.

An increasingly accepted typology, originally suggested by the Millennium Ecosystem Assessment, divides ecosystem services into four basic categories (Millennium Ecosystem Assessment 2003, 56–60):

1) *Provisioning services:* goods, such as food or freshwater, that ecosystems provide and humans consume or use
2) *Regulatory services:* services, such as flood reduction and water purification, that healthy natural systems, such as wetlands, can provide
3) *Cultural services:* intangible benefits, such as aesthetic enjoyment or religious inspiration, that nature often provides
4) *Supporting services:* basic processes and functions, such as soil formation and nutrient cycling, that are critical to the provision of the first three types of ecosystem services

Studies have contended that these ecosystem services provide vast economic value to society. In an early and controversial study, Costanza and colleagues (1997) estimated that ecosystem services provided between US $16 trillion and US $54 trillion per year in value, likely outstripping the yearly global GDP at the time of US $19 trillion. While economists faulted the Costanza study's methodology, all agree that the economic value of ecosystem services is vast (e.g., Heal 2000; Pearce 1998).

Over the last decade, scientists and other researchers have promoted the concept of ecosystem services and studied how it might help improve environmental management. A major global study, the Millennium Ecosystem Assessment, examined the state of ecosystems and ecosystem services throughout the world and found that most ecosystem services declined in the last half of the 20th century, while only four services (crops, livestock, aquaculture, and carbon sequestration) improved (Millennium Ecosystem Assessment 2005).

Both global and domestic environmental agencies have launched research programs to study the relevance of ecosystem services to their work (e.g., U.S. Environmental Protection Agency 2006). A growing number of research universities and non-governmental organizations have created programs to help measure, value, and evaluate ecosystem services, such as The Natural Capital Project, a joint venture among Stanford University, The Nature Conservancy, the World Wildlife Fund, and the University of Minnesota (Kareiva et al. 2011).

As already noted, ecosystem services are not a new concept, although terms such as “ecosystem service” and “natural capital” are of recent vintage. The recent surge in studies and scholarship surrounding ecosystem services, however, has dramatically increased attention to the concept in policy circles. As a result, an increasing number of governments have explicitly incorporated ecosystem services into their laws and policies (Thompson 2008). Current scholarship on ecosystem services has also changed the way in which policy-makers and others now think about the concept. Rather than looking at ecosystem services on an individual basis, recent scholarship has emphasized that ecosystems can provide a large range of different services. The scholarship also has increasingly sought to value the services, and to develop new, easily replicable methods of valuing them for public and private purposes (Kareiva et al. 2011). This in turn has helped highlight the tremendous value that ecosystem services provide humans, including value that is directly translatable into economic terms. The rest of this paper examines how the current wave of interest in ecosystem services may influence environmental policy.

ALTERNATIVE FRAMEWORKS FOR ENVIRONMENTAL INTERVENTION

The frameworks used to justify environmental interventions help explain the tools that policy-makers and practitioners have used to protect the environment. They also provide insight into how the concept of ecosystem services might help, or hinder, environmental protection. Three frameworks historically have dominated discussions: market failures, sustainable development, and environmental rights. While these frameworks are often reinforcing, they also can cut against each other in some settings, with one or another framework providing support for a policy intervention while the others militate against. The frameworks also can point to very different solutions even where intervention appears justified (Salzman and Thompson 2010, 28–29), and they are likely to lead people to see ecosystem services in very different lights.

Market Failures

The first framework, “market failures,” takes an unabashedly utilitarian approach to the environment. The goal is to maximize economic benefit to society, and the government should intervene where the market fails to adequately account for environmental benefits. Economists have identified a number of such failures, e.g., public goods, the tragedy of the commons, and externalities (Tietenberg and Lewis 2008, 65–88). Many environmental amenities, including important ecosystem services, are “public goods” shared by everyone and difficult to privatize. As a result, in a market economy no one has a strong incentive to contribute to their protection. For example, everyone benefits from clean air, but because the benefits are shared, there is no market for clean air; except for charitable contributions to environmental organizations, no one voluntarily pays to protect and clean up the air. Absent policy interventions, the result in a market economy will be dirty air.

Air pollution is also an example of the concept called the “tragedy of the commons,” which holds that where a resource is commonly held by everyone, each individual has a personal incentive to use and abuse the resource until its value is collectively impaired or destroyed. Because air is shared in common, for example, companies and individuals in a market economy pump carbon into it, even though that will lead to climate change. Where a fishery is open to all, fishermen often overfish until it collapses. If everyone overlying a groundwater

aquifer is entitled to pump from it with no restriction, they will overdraft the aquifer until water tables drop to a level where pumping groundwater is no longer economical.

A final way to see how environmental problems result from market failures is through the framework of "negative externalities." In making decisions in a market economy, businesses and individuals take private benefits and costs into account. However, where their actions result in a cost or benefit to someone whom they cannot charge, they will not consider that externality in making their decisions. Discharging carbon dioxide into the air contributes to climate change, but businesses and drivers have no economic reason to consider that cost because the marketplace does not force them to pay it.

Psychologists and policy experts also have shown that people suffer from many cognitive biases that prevent them from making decisions that will maximize their long-term welfare where various environmental issues are involved (Thompson 2000a). For example, imagine a fisherman trying to decide how many fish to catch in a year. As noted, if the fishery is open to all, the tragedy of the commons will lead to overfishing. However, if there is any uncertainty regarding the sustainable fishing level, over-optimism is likely to lead the fisherman to overestimate the number of fish it is safe to catch, even if the problem of the commons can be overcome. The fisherman is also likely to assume that any overfishing that occurs is the result of someone else's fishing practices, not his own.

The growing literature on ecosystem services meshes nicely with the utilitarian perspective that underlies the market-failure framework. By emphasizing the instrumental value of nature to humans, the concept of ecosystem services helps explain why it is important to protect and restore ecosystems. However, knowing that ecosystems provide valuable services to society does not solve market failures; it simply highlights the reason for doing so. As noted above, most ecosystem services are public goods and thus very difficult to protect through private markets (Thompson 2012). By providing insights into the value of conservation and environmental protection, however, the concept of ecosystem services can help policy-makers determine what and how much to regulate.

Sustainable Development

The concept of sustainable development provides an alternative framework for environmental intervention that shares a common lineage with much that has been written on ecosystem services (Tallis et al. 2008, 9458). Sustainable development begins with the premise that resources and environmental amenities are essential to meeting societal needs, but are finite in quality and sometimes fragile. For economic development to be sustainable, government therefore must ensure that each generation meets its needs in ways that do not exhaust resources or destroy the life-support systems of the planet (including natural capital). Otherwise, future generations will not be able to meet their needs.

Sustainable development thus stresses intergenerational equity and the critical importance of natural resources and ecosystem services (Pearce 1988). Unfortunately, neither markets nor political systems have fully accounted for the needs of future generations. Because of the time value of money, markets discount benefits to future generations. And the frequency of democratic elections drives politicians to focus more on the needs of current voters than the future needs of children or the unborn. Sustainable development calls for the use of longer time horizons in making decisions that affect the environment and resources.

Because sustainable development recognizes that natural resources are not inexhaustible and that ecosystem services are fragile, under its framework, governments should manage resources that are non-renewable, such as groundwater and fisheries, to avoid over depletion and collapse. Governments also should protect areas such as forests that provide services, such as carbon sequestration and dependable water flows that are critical to meeting the needs of not only the current but also future generations. Ecosystem services are thus a cornerstone of sustainable development. Because nature provides services that are central to human well-being and productive activity, any society that tries to develop at the expense of its natural environment will not be sustainable in the long run.

Environmental Rights

A third framework looks at environmental issues from the perspective of human rights (Nash 1989). Under this framework, the respective economic benefits and costs of improving or protecting the environment are largely irrelevant. Instead, environmental protection is a human right that all members of society have an obligation to protect. Under this perspective, looking at the environment through a utilitarian framework is both wrong and potentially dangerous.

The environmental rights perspective is embodied in the 1972 Stockholm Declaration of the United Nations Conference on the Human Environment, which states the "common conviction" that people have a "fundamental right to freedom, equality, and adequate conditions of life, in an environment of a quality that permits a life of dignity and wellbeing," as well as a "solemn responsibility to protect and improve the environment for present and future generations" (Sohn 1973). A handful of nations, as well as several states in the United States, also explicitly provide for environmental rights in their constitutions (Thompson 2006; Hayward 2005; Thompson 1996).

Most international and constitutional rights to environmental protection are anthropocentric; they focus on rights that current and future generations of humans have to a healthy and livable environment. However, some environmental advocates and philosophers have argued that environmental rights exist independently of the rights and interests of humans. Under the framework of "biocentric rights," plants and animals also have rights that must be protected. Under an even broader "ecocentric" perceptive, nature as a whole, not just individual species, has rights that humans should protect (Salzman and Thompson 2010, 30–31).

This final framework is not necessarily inconsistent with greater emphasis on ecosystem services. Understanding how humans benefit from ecosystem services, for example, can help explain why humans have a right to an environment that continues to produce such services. However, the recent emphasis on measuring and valuing ecosystem services creates a tension within a rights-based approach, which holds that society should protect ecosystems because it's the moral thing to do, not because of the economic value of ecosystem services or other elements of the environment. Indeed, as discussed in more detail in "Potential Issues and Challenges," below, trying to place a value on nature might actually undermine people's environmental rights by suggesting that society should protect nature only when the value of the protection outweighs the costs (Redford and Adams 2009, 785–786).

TRADITIONAL MANAGEMENT APPROACHES

Ecosystem services do not provide a totally new approach to managing the environment. The general categories of tools that we use to manage the environment today are likely to remain the same in the future. However, the concept of ecosystem services provides an approach for improving and expanding a number of the traditional tools, which fall into at least five broad categories: prescriptive regulation, property rights, financial incentives, direct governmental acquisition and protection of environmental amenities, and persuasion. As described in more detail in "How Thinking in Terms of Ecosystem Services Might Help," ecosystem services provide a useful framework for rethinking and improving tools in all five of these categories.

Prescriptive Regulation

Often labeled "command and control," prescriptive regulation directly dictates what individuals and organizations can and cannot do, typically by restricting activities or actions that could harm the environment (Salzman and Thompson 2010, 47). Most major environmental laws in the United States, ranging from the Clean Air Act to the Endangered Species Act, use prescriptive regulation. Some prescriptive measures regulate processes (e.g., by mandating that farmers use best management practices), while others mandate particular performance standards but leave it up to the regulated entities to determine how to meet those standard (e.g., the Endangered Species Act requires only that activities not "take" an endangered species).

The value of ecosystem service concepts to prescriptive regulation depends in part on how the government sets its standards. Standards are often set by government based on human welfare considerations or through balancing the benefits and costs. For example, so-called "secondary" ambient air-quality standards under the U.S. Clean Air Act must be sufficient to protect the public welfare (42 U.S.C. § 7409(b)), and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) prohibits the use of pesticides that present an "unreasonable risk to man or the environment" (7 U.S.C. §§ 136(bb) and 136a(c)(5)). In these cases, the ability to measure and value ecosystem services could provide a more rigorous means of setting regulatory standards and, in some cases, help justify stronger governmental regulations.

The pervasiveness of ecosystem services also suggests that laws aimed at protecting individual services, such as the Endangered Species Act, may be too narrowly focused, leading to the protection of land, water, or other resources that do not maximize the entire suite of services. In other cases, however, the government sets standards based on technological or economic feasibility. For example, the U.S. Clean Water Act sets pollution-discharge standards based largely on available technology (Sax et al. 2006, 1018–1023). In these cases, knowing the value of ecosystem services would not affect the regulatory standards.

Governments increasingly have sought ways to make prescriptive regulation more flexible and reduce its costs. "Cap-and-trade" systems are one such approach, in which the government sets an overall standard for pollution or resource consumption, then allows private entities to determine how to allocate the limited amount of permitted pollution or resource consumption through market trades. Water markets and carbon markets are examples of cap-and-trade systems. Mitigation is another mechanism commonly used to make regulations more flexible, by allowing people to engage in activities that are harmful to the environment only if they mitigate the injury through some form of compensatory behavior. For example, the United States sometimes allows wetlands to be modified or destroyed if the action is mitigated by restoring, enhancing, or creating wetlands elsewhere.

Ecosystem services can help improve such mechanisms by providing a metric for determining when two actions are equivalent. The ability to judge equivalency is central to cap-and-trade systems, mitigation, and similar flexible approaches (Salzman and Ruhl 2000). If, for example, the government must decide whether to permit a wetland to be developed in return for restoring a wetland elsewhere, it needs to know whether the two wetlands are at least approximately equivalent in terms of the benefits they provide. Comparing the wetlands might be difficult in the abstract, but measuring and valuing the ecosystem services generated by each can provide the government with a meaningful and effective way to compare them.

Property Rights

Where environmental degradation results from the tragedy of the commons, a potential solution is to reconfigure property rights either publicly or privately. For example, oil and gas production in the United States can lead to overpumping because all private landowners overlying a petroleum reservoir share a common right to pump oil and gas from the reservoir. A frequently employed solution is unification of the reservoir, which designates a single entity to manage petroleum extraction and then divide profits among the overlying owners. Similarly, a potential solution to overfishing is to award one group the exclusive right to fish a particular area, often referred to as territorial use rights in fisheries, or TURF (Christy 1992). A growing number of countries are also assigning individual quota shares to fishermen, to give them a financial stake in the sustainability of their fisheries (Costello et al. 2008).

Ecosystem services do not suggest improvements to property-rights approaches, but the importance of property rights to solving some forms of environmental problems suggests that policy-makers should consider how property rights might be used to help protect ecosystem services. For example, landowners might be able to increase water availability by retaining forests, protecting areas of groundwater recharge, or eliminating phreatophytes from river banks. In many parts of the world, however, landowners have no formal right to the water they protect or "produce" through such measures, undermining their ability to request payment from water consumers for adopting them. Reconfiguring water rights to reward such behaviors could thus help promote sustainable water flows (although other market failures, from lack of information to free riders, might still undermine any effort to establish a market incentive) (Thompson 2008, 477–478).

Financial Incentives

Economists have long pushed the use of financial incentives to improve environmental behavior, ranging from taxes and fees on bad behavior to subsidies or other positive incentives for good behavior (Hahn and Stavins 1992). In practice, few governments have made active use of taxes and fees to encourage good environmental behavior; while governments sometimes impose taxes or fees to help pay for regulatory programs, the amounts imposed have seldom provided a significant incentive to change behavior (Hahn 1989). By contrast, governments often subsidize environmentally beneficial behavior. For example, in the United States, the federal Farm Bill invested over US $4 billion per year in a wide variety of conservation and environmental payment programs during the first decade of the century (Cox 2008). Not surprisingly, policy-makers have found positive financial incentives an easier sell than taxes and other forms of negative incentives.

A broader and more complete understanding of ecosystem services can help justify the use of positive incentives. In using scarce governmental funds to promote particular environmental behavior, policy-makers generally would like to show that the funds generate equal or greater public benefits. Recognition that the preservation of forested lands will generate valuable ecosystem services has already led a growing number of national and local governments to set up programs that pay landowners to protect and manage the lands (payment for ecosystem services, or PES, programs) (Jack et al. 2008).

An improved understanding of ecosystem services could also enable the government to better direct incentives payments. Using the Farm Bill as an example again, most of its incentive programs are narrowly focused on a limited set of ecosystem types and services, even though well-managed agricultural lands can provide a wide variety of services. Moreover, many of the programs award incentives to individual farmers even when broader, landscape-scale or watershed-scale actions are needed to protect and enhance many services. If driven by and designed to protect a broader set of ecosystem services, the Farm Bill's conservation programs could deliver much higher value for every dollar spent than it does today (Goldman et al. 2008; Arha et al. 2008).

Greater understanding of ecosystem services could also help enable greater use of negative incentives. One of the major obstacles to using environmental taxes and fees is the ability to measure and value environmental harms. To ensure efficient behavior, "Pigouvian" taxes or fees should approximate the cost of the harm of the activity for which they are charged, but that cost has often been hard to estimate (Cropper and Oates 1992). An improved ability to measure and value ecosystem services thus could provide the foundation for the use of a broad set of fees or taxes (although political obstacles would still remain prominent).

Direct Governmental Acquisition and Management

A fourth means by which the government sometimes protects environmental amenities is by direct government acquisition (or retention) and management of the land or other resource that generates the amenities. Thus most governments acquire or set aside land to protect as public parks, forests, or other preserves. In the United States, four major national land agencies (the Forest Service, Bureau of Land Management, Fish and Wildlife Service, and National Park Service) manage over 600 million acres of land, almost half of which is actively managed for conservation (Thompson 2002, 247–248).

An enhanced understanding of ecosystem services once again can help improve a government's selection and management of environmentally valuable lands and resources (as well as justify governmental action). Governmental agencies often enjoy substantial discretion in managing public lands, partly because of the traditional difficulty in developing metrics for measuring and thus evaluating effective management. Ecosystem services, where measurable, can provide at least one set of metrics that are keyed to the reasons why nations often have established public holdings (Thompson 2008, 486–487).

Persuasion

The government also tries to influence behavior through persuasion, which can take several forms. One is to force individuals and organizations to reflect on their actions, and the possible effect of those actions on the environment, before moving forward. Most governments, for example, require some assessment of environmental impacts before allowing major actions that could significantly harm the environment (Wathern 1988). In other cases, governments provide information to help individuals or organizations make more informed and hopefully better decisions. California, for example, provides warnings to potential consumers of products known to carcinogenic or to contain reproductive toxins (Stephan 2002). Finally, governments often seek to influence behavior or social norms through marketing campaigns and educational programs. Examples include governmental efforts to encourage conservation of energy and water, to promote recycling, and to reduce tobacco use (Hastings and Saren 2003).

As discussed in the next section, the concept of ecosystem services may provide a new mechanism for helping the public understand why it is important to protect nature. For those individuals who care more about economic well-being than environmental equity, ecosystem services may provide greater resonance to traditional arguments for sustainable behavior.

HOW THINKING IN TERMS OF ECOSYSTEM SERVICES MIGHT HELP

As suggested in the previous section, increased understanding of ecosystem services can help promote environmental stewardship in a number of ways. This section considers three major possibilities: First, that ecosystem services may provide a conceptual shift in the way people think about conservation, increasing public support for conservation efforts. Second, that a better understanding of ecosystem services might improve governments' ability to measure the benefits of particular environmental actions, enabling better goal-setting and program evaluation. Finally, that ecosystem services might open up new opportunities for environmental markets.

Shifting People's Understanding of the Value of Conservation

Many policy advocates have hoped that greater appreciation for the extent and value of ecosystem services will lead to increased public and private support for conservation (e.g., Daily et al. 2009; Salzman et al. 2001). Although ethical considerations lead many people to protect the environment, more utilitarian considerations drive many others. By emphasizing the connection between the environment and human well-being, a better understanding of ecosystem services might convince more of the latter group that protecting the environment is valuable. More generally, a better understanding of the connection could lead to greater support for conservation measures.

This thesis finds some support in a range of governmental actions over the last two decades designed to protect ecosystem services. For example, a handful of national governments have created programs to conserve land for the ecosystem services that they produce. In the late 1990s, Costa Rica created a new program to pay landowners to protect forested land for a variety of ecosystem services, including hydrological services, carbon sequestration, biodiversity protection, and scenic beauty (Paglioa 2008). China is in the process of establishing vast ecosystem-service reserves.

At the local level, a growing number of cities in South America have established water funds to pay landowners in their watersheds to manage their lands in ways that do not threaten water quality. In the United States, cities such as New York and Boston also have

invested in land conservation in their watersheds in order to protect water quality and thereby avoid the need to filter water from those areas (Postel and Thompson 2005). Legislatures in both Hawai'i and Washington have adopted similar legislation.

Various U.S. states also have shown an increased interest in ecosystem services. For example, in 2006 Hawai'i's House of Representatives requested the Hawai'ian government to assess incentives for the conservation of private lands and "the public benefits of the ecosystem services provided by those lands," and to recommend opportunities for reforms. The House resolution emphasized the need to think of "the environment not as a 'free good,' but as a capital resource that will depreciate without appropriate care" (House Concurrent Res. No. 200, Haw. 23rd Leg.). The state's Department of Department of Land and Natural Resources responded with a report calling for a series of reforms, including a Hawai'i Fund for Conservation that would "link buyers and sellers of ecosystem services, standardize conservation credits and lower transaction costs for those who are considering investment in Hawai'i's biodiversity and ecosystem services" (Hawai'i Dept. of Land and Natural Resources 2007). In 2008, the Washington state legislature ordered a study of how ecosystem-service markets might promote conservation practices on agricultural and forestry lands (S.B. 6805, Wash. 60th Leg., 2008 Reg. Sess.).

One nonetheless can question how effective the effort to increase understanding of ecosystem services by the public and policy-makers has proven in encouraging new conservation measures that otherwise would not have been adopted. Most nations, including the United States, have adopted virtually no new policies in response to the increased attention to ecosystem services. The United States Code contains only two laws that even refer to ecosystem services: a provision of the 2008 Farm Bill that creates a new office in the Department of Agriculture to promote ecosystem-service markets (16 U.S.C. § 1845), and a directive that federal research on oceans and the atmosphere should include ecosystem services (33 U.S.C. § 893).

Members of Congress have mentioned ecosystem services approximately 40 times on the floor of either the House or Senate since 1985 (e.g., 157 Cong. Rec. E249, E1209), but the concept never appears to have played a major role in a debate over important legislation. Federal agencies have taken to the concept more readily; the term appeared 164 times in the Federal Record in 2011. However, most of these mentions dealt with research, not actual policy, and were far outnumbered by the 1,281 references to more standard concepts such as biodiversity. While states like Hawai'i and Washington have expressed interest in and studied how to promote the protection of ecosystem services, improved understanding of ecosystem services has yet to inspire any state to adopt new on-the-ground conservation measures.

Long-standing laws, rather than an emerging understanding of ecosystem services, have driven many local investments in ecosystem services. Consider, for example, the efforts by New York, Boston, and other cities to protect their watersheds. There is no evidence that such efforts stemmed from a new or improved understanding of ecosystem services by city officials. Instead, the United States Safe Drinking Water Act has long given cities the option of either protecting their watershed or filtering their water (42 U.S.C. §§ 300f–300j; 40 C.F.R. § 141.70–.75 (2007)). Given the cost of filtering, many large cities have chosen to protect their watersheds. A 2005 study of major water suppliers in California found that few had purchased new lands or conservation easements in the prior decade to protect their watersheds, in part because water suppliers had no sense of the actual value of the land conservation to their efforts to protect water quality (Thompson 2008; Postel and Thompson 2005).

There also are more theoretical reasons to question how much the concept of ecosystem services will dramatically shift policy debates in favor of greater conservation (Thompson 2008). First, many of the major ecosystem services of greatest interest to the public are not new to policy debates. Arguments for conservation have long rested on the importance of ecosystem services such as clean water, flood protection, and, more recently, carbon sequestration. Second, the concept of ecosystem services does not address the major structural problems standing in the way of increased conservation, including the diffuse nature of the public's interest in conservation and the concentrated opposition of major industrial interests such as mining, development, and agriculture.

How significant an impact the concept of ecosystem services will have on conservation policies throughout the world is therefore still an open question. Research on ecosystem services as a whole is still relatively new, and the general concept has only recently picked up momentum in public discussions. Current efforts to measure ecosystem services and value them in economic and other terms may prove particularly useful in convincing skeptics that ecosystem services are worth protecting. However, it is not yet clear whether new studies, models, and data are likely to sway votes and support for conservation from policy-makers who have not been swayed by more traditional arguments.

Providing Improved Measures of Environmental Benefits and Performance

Current studies of ecosystem services may hold greater promise for providing improved measures of environmental benefits and performance. Such measures are important in at least four contexts. First, measures of environmental benefits are important in justifying environmental regulations. In the United States, every president since Richard Nixon has required agencies to conduct cost-benefit

analyses before adopting major environmental regulations (e.g., Exec. Order 13563). A handful of U.S. environmental laws, such as FIFRA and the Toxic Substances Control Act, explicitly require the Environmental Protection Agency (EPA) to balance benefits and costs in setting appropriate regulations (Salzman and Thompson 2010, 35).

While cost-benefit analyses have long incorporated health benefits from environmental regulations, agencies have had a more difficult time quantifying and thus formally incorporating their ecological benefits (U.S. Environmental Protection Agency Science Advisory Board 2009). To the degree that agencies have been able to identify ecological benefits, they are generally included in cost-benefit analyses only as a qualitative factor. New research on measuring and valuing ecosystem services thus holds out the promise of allowing agencies to quantify more of the benefits of their regulations, and thus provide stronger justification for them. For this reason, the EPA's Science Advisory Board (2009) has recommended increased support for such research and its incorporation into cost-benefit analyses.

Second, the ability to measure and value ecosystem services also could help agencies better implement the regulatory and managerial discretion that they enjoy, as well as enable other branches of government to evaluate how well various programs are being carried out. Some statutes provide agencies with only general instructions regarding their actions. For example, the Multiple-Use Sustained-Yield Act instructs the Secretary of Agriculture to "develop and administer the renewable surface resources of the national forests for multiple use and sustained yield of the several products and services obtained therefrom," and notes that it is the "policy of the Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes" (16 U.S.C. §§ 528, 529). Improved measurement and valuation of ecosystem services could help the Department of Agriculture in determining how to manage the national forests with maximum use and sustained yield in mind, and in making inevitable tradeoffs among uses. Similarly, courts could use ecosystem services to provide more concrete meaning to the general obligations of the public trust doctrine (Ruhl and Salzman 2007).

Third, the ability to measure and value ecosystem services could help encourage agencies that have historically focused their administration of particular laws on human-health concerns to pursue broader ecological benefits as well. For example, the EPA's administration of the Superfund program historically has focused on reducing and managing risks to human health from toxic substances. Evaluation and cleanups of Superfund sites seldom considered the impact of contamination on ecosystem services, or ways in which a restored site could benefit ecosystem services. More recently, however, improved understanding of ecosystem services has led some cleanup efforts to design plans that can increase the local supply of such services (Thompson 2006).

Finally, as discussed earlier, improved measurement and valuation of ecosystem services can help ensure that trading and mitigation systems do not accidentally reduce environmental protection. Where regulations are designed to protect ecological assets such as wetlands or habitat, trading or mitigation programs must be able to compare the assets that are involved in a trade or mitigation proposal. The ability to measure and, in some cases, value ecosystem services is critical to such comparisons (Ruhl et al. 2009).

Creating New Markets for Ecosystem Services

Some experts on ecosystem services have held out hope that a better understanding of ecosystem services and their value would lead to ecosystem-service markets that would promote increased conservation (e.g., Guteri 2005; Chichilnisky and Heal 1998). Investments made by public and private entities to protect ecosystem services have helped spur such hopes. As already noted, New York and other cities have spent money to protect their watersheds in order to ensure high water quality. Some water-dependent companies, such as Perrier-Vittel, have purchased lands to protect the quality of their water (Economist 2005). A few regions, such as Napa County, have invested in the restoration and protection of wetlands and other riparian lands for the flood protection they provide (Salzman et al. 2001). The rapid rise of carbon markets in Europe and other parts of the world has led entrepreneurs to wonder whether similar markets could develop in other ecosystem services. Hopes for ecosystem-service markets, in turn, have led a variety of governments to investigate options for promoting such markets (Thompson 2008).

In considering the opportunity for ecosystem-service markets, it is important to make two important distinctions. The first is between "spontaneous" markets (which do not need governmental pressure) and regulatory markets (which develop from regulatory pressure). Spontaneous ecosystem-service markets are attractive because they promise greater conservation investment without the need for political change. Perrier-Vittel's conservation of lands overlying one of its major groundwater sources is an example; the company invested in conservation because of the value of the services the land provided, not because of any governmental policy. Unfortunately, there are exceptionally few examples of spontaneous ecosystem-service markets. Nor should one expect many examples because, as noted earlier, ecosystem services are public goods for which robust private markets are unlikely to arise (except as a result of philanthropic spending) (Thompson 2012).

Governmental regulation drives most markets for ecosystem services. New York City invested in conservation in its Catskills watershed because of the Safe Drinking Water Act. Section 404 of the Clean Water Act, which restricts modification of wetlands, and its mitigation

program have driven markets for wetlands conservation in the United States (Fox et al. 2006). Climate laws, or the prospect thereof, have driven markets for carbon sequestration. In all of these cases, governmental regulation has been the catalytic force behind the ecosystem-service markets (Victor and House 2004). Rather than ecosystem services driving markets and new investments, governmental intervention leads to protection of the ecosystem services through markets. The question then arises whether ecosystem services could drive new governmental regulation that otherwise would not pass. Not surprisingly, legislatures have been more enthralled with the possibility that they could help promote spontaneous markets than with passing new regulations.

Another important distinction is between geographically large commodity markets (such as the market for carbon credits) and local heterogeneous markets (such as wetland banks under Section 404 of the Clean Water Act). Commodity markets involve trades among relatively comparable goods. As a result, they tend to have low transaction costs and a large volume. By contrast, trades in local heterogeneous markets require often difficult comparisons among goods or services. Such markets are often thin and have high transaction costs, leading to far fewer trades. Unfortunately, most ecosystem-service markets promise to be local and heterogeneous.

Markets will remain an important instrument for promoting environmental goals. However, for the reasons just discussed, it is unlikely that a growing appreciation for ecosystem services will lead to significant new markets absent governmental pressure, and thus to new private investments in the ecosystems that produce the services. The greatest opportunity lies in those services where a single entity receives a disproportionate share of the benefits. Spontaneous markets may arise in these situations because the service takes on more of the qualities of a private good. For example, major water suppliers may be the primary beneficiaries of watershed protection, which could help explain why a number of South American cities have begun to invest in water funds.

POTENTIAL ISSUES AND CHALLENGES

While the concept of ecosystem services offers potential policy advantages, integrating ecosystem services into environmental policies also poses a variety of both practical implementation challenges and political-ethical issues.

Practical Challenges

As suggested, the use of ecosystem services to advance conservation presents a number of practical challenges. The first is developing models and methods for predicting how particular policies will affect ecosystem services that are important to the public. Without “ecosystem production functions” that connect particular ecosystem characteristics with a flow of services, it is impossible to determine how particular policies will affect those services. Ecologists, who historically did not characterize ecosystems in ways that could directly translate to their services, are currently developing new models. If ecosystem services are to become a common motivator, such models must be able to determine, at relatively low cost, the impact of particular policy measures (U.S. Environmental Protection Agency Scientific Advisory Board 2009).

A second practical challenge is valuing ecosystem services. Because many ecosystem services are public goods that do not have active markets, valuation can be highly uncertain. Most valuation efforts to date, moreover, have been monetary. Non-monetary valuation is likely to be more relevant to many societies, but methods to produce non-monetary values are still in their infancy and often very controversial (U.S. Environmental Protection Agency Science Advisory Board 2009). All forms of valuation require active interdisciplinary collaboration.

Political-Ethical Issues

The current interest in using ecosystem services to promote conservation has drawn significant political-ethical criticism. For example, as noted earlier, ecosystem services emphasize the human values of ecosystems, and thus policies based on ecosystem services are likely to trumpet human values rather than broader notions of environmental ethics. For those who believe that society should protect the environment for biocentric or ecocentric reasons, focusing on ecosystem services may threaten to shift policy attention away from what they believe is the critical issue: what are society's obligations to nature?

Such a shift might not be a problem, at least in terms of ultimate consequences, if ecosystem-service arguments can accomplish the same quantity and quality of conservation as ethical arguments. Proponents of broader ethical arguments, however, may fear that ecosystem-service arguments may never be sufficiently convincing to a broad segment of the public, and that greater attention should instead be paid to promoting ethical arguments. These proponents may also fear that ecosystem-service arguments will not support the same type or degree of conservation as ethical arguments might (Redford and Adams 2009). For example, ecosystem-service arguments might support modified or engineered ecosystems that maximize the flow of services even if the ecosystems lose significant aspects of their

"naturalness" (e.g., native species). Ecosystem-service arguments similarly might provide only weak support, at best, for the conservation of apparently "unnecessary" parts of an ecosystem (i.e., those parts that do not appear to be necessary in order to provide significant ecosystem services). Ecosystem-service arguments might also justify the elimination of ecosystem characteristics that could be viewed as potentially harmful to humans.

A potential response to these concerns is that ecosystem services and environmental ethics can be complementary rather than competitive arguments (Thompson 2002). In theory, one could argue that policies should promote conservation because of both ecosystem services and environmental rights. The question is whether this is possible, or if an ecosystem-service argument is likely to crowd out arguments based on environmental ethics. Unfortunately, no empirical or experiential evidence currently provides an answer to this question. Proponents of ecosystem-service arguments believe that it is worth the risk to try a new approach to convincing the public of the importance of conservation. At least some environmental ethicists have their doubts.

Efforts to value ecosystem services monetarily heighten the tension. Placing a monetary value on ecosystem services assigns a numerical value to nature. More important, it would appear to buy into the same neoclassical framework that argues for subjecting environmental regulation to cost-benefit analysis. Monetary valuation thus would seem to directly conflict with ethical arguments for environmental protection. Placing a monetary value on ecosystem services would also suggest that some services (perhaps those that are close to human settlements) are more valuable than other services (Redford and Adams 2009).

Markets for ecosystem services pose particular problems for individuals who believe in environmental rights and obligations. First, the promise of ecosystem-service markets might undermine arguments for environmental regulation by suggesting that new or strengthened regulation is unnecessary. For example, if water funds can help protect watersheds, legislators may be less likely to support laws requiring watershed protection. This could be a particularly serious problem to the degree that regulation is more likely than markets to shape societal attitudes about conservation (Thompson 2002). Second, ecosystem-service markets may implicitly suggest that society should allocate ecosystem services based on ability and willingness to pay. Rather than rights, ecosystem services become commodities, much like cell phones or light bulbs.

Markets for ecosystem services similarly present a baseline problem: what services should landowners be required to provide even if they are not paid? Few would argue that society should pay landowners not to pollute a river running through their property; why then should society pay landowners to protect riparian lands that are important in providing high-quality water? From the perspective of the ethicist, should society pay landowners for something they have an ethical obligation to do?

CONCLUSION

The concept of ecosystem services holds out the promise of increasing and improving conservation in at least three ways. First, ecosystem services may provide a new and resonant argument for conservation by demonstrating the enormous value of conservation to society. Second, ecosystem services might provide a framework for better specifying the purposes of environmental management and for expanding its purposes. Finally, ecosystem services might provide the basis for new markets that could increase the funds flowing into conservation. Of these opportunities, the second currently appears to be the strongest. Moreover, recognizing and embracing all the potential benefits depends on being able to better measure and value ecosystem services.

Any effort to focus debate over environmental policies around ecosystem services, however, is likely to generate controversy. Ecosystem services focus on the human value of conservation, which some environmentalists fear may undercut ethical arguments. Efforts to put a monetary value on ecosystem services and to develop ecosystem-service markets increase the friction between these two very different perspectives on environmental policy.

REFERENCES

Arha, K., T. Josling, D. A. Sumner, and B. H. Thompson. 2008. Conserving ecosystem services across agrarian landscapes. In *U.S. agricultural policy and the 2007 farm bill*, ed. K. Arha, T. Josling, D. A. Sumner, and B. H. Thompson: 107–229. Stanford, CA: Woods Institute for the Environment.

Chichilnisky, G., and G. Heal. 1998. "Economic returns from the biosphere." *Nature* 391:629–630.

Christy, F. T., Jr. 1992. *Territorial use rights in marine fisheries: Definitions and conditions.* FAO Fisheries Technical Paper No. 227.

Costanza, R., R. d'Arge, R. De Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Paruelo, R. G. Raskin, P. Sutton, and M. Van Den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253–260.

Costello, C., S. D. Gaines, and J. Lynham. 2008. Can catch shares prevent fisheries collapse? *Science* 321:1678–1681.

Cox, Craig. 2008. U.S. agriculture conservation policy and programs: History, trends, and implications. In *U.S. agricultural policy and the 2007 farm bill*, ed. K. Arha, T. Josling, D. A. Sumner, and B. H. Thompson: 113–145. Stanford, CA: Woods Institute for the Environment.

Cropper, Ma. L., and W. E. Oates. 1992. Environmental markets: A survey. *Journal of Economic Literature* 30:675–740.

Daily, G. C. 1997. *Nature's services: Societal dependence on natural ecosystems.* Washington, DC: Island Press.

Daily, G. C., and P. A. Matson. 2008. Ecosystem services: From theory to implementation." *Proceedings of the National Academy of Sciences* 105:9455–9456.

Daily, G. C., S. Polasky, J. Goldstein, P. M. Kareiva, H. A. Mooney, L. Pejchar, T. H. Ricketts, J. Salzman, and R. Shallenberger. 2009. Ecosystem services in decision making: Time to deliver. *Frontiers in Ecology and the Environment* 7(1):21–28.

Economist 2005 April 23. Are you being served?

Fox, J., G. C. Daily, B. H. Thompson, Jr., K. M. A. Chan, A. Davis, and A. Nino-Murcia. 2006. Conservation banking. In *The endangered species act at thirty,* ed. D. D. Goble, J. M. Scott, and F. W. Davis, 2:228–234. Washington, DC: Island Press.

Goldman, R. L., B. H. Thompson, and G. C. Daily. 2008. Managing for ecosystem services on U.S. agricultural lands. In *U.S. agricultural policy and the 2007 farm bill*, ed. K. Arha, T. Josling, D. A. Sumner, and B. H. Thompson: 97–111. Stanford, CA: Woods Institute for the Environment.

Guteri, F. 2005 June 6. Investing in green. *Newsweek*.

Hahn, R. W. 1989. Economic prescriptions for environmental problems: How the patient followed the doctor's orders." *The Journal of Economic Perspectives* 3:95–114.

Hahn, R. W., and R. N. Stavins. 1992. Economic incentives for environmental protection: Integrating theory and practice." *American Economic Review* 82:464–468.

Hastings, G., and M. Saren. 2003. The critical contribution of social marketing: Theory and application." *Marketing Theory* 3:305–322.

Hawai'i Department of Land and Natural Resources. 2007. *Final report to the Twenty-Fourth Legislature, regular session of 2008, requesting the Department of Land and Natural Resources to conduct an analysis of incentives to promote landowner protection of important Mauka lands.* http://hawaii.gov/dlnr/reports-to-the-legislature/2008/2008/division-of-forestry-wildlife/FW08-Important-Mauka-Lands-Report.pdf.

Hayward, T. 2005. *Constitutional environmental rights.* Oxford: Oxford University Press.

Heal, G. 2000. *Nature and the marketplace: Capturing the value of ecosystem services.* Washington, DC: Island Press.

Jack, B. K., C. Kousky, and K. R. E. Sims. 2008. Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms." *Proceedings of the National Academy of Sciences* 105:9465–9470.

Kareiva, P., H. Tallis, T. H. Ricketts, G. C. Daily, and S. Polasky. 2011. *Natural capital: Theory and practice of mapping ecosystem services.* Oxford: Oxford University Press.

Millennium Ecosystem Assessment. 2003. *Ecosystems and human well-being: A framework for assessment.* Washington, DC: Island Press.

———. 2005. *Ecosystems and human well-being: Synthesis.* Washington, DC: Island Press.

Nash, R. 1989. *The rights of nature: A history of environmental ethics.* Madison, WI: University of Wisconsin Press.

Organic Administration Act of June 4, 1897. 16 U.S.C. § 475.

Paglioa, S. 2008. Payments for environmental services in Costa Rica. *Ecological Economics* 65:712–724.

Pearce, D. 1998. Auditing the Earth: The value of the world's ecosystem services and natural capital. *Environment* 40(2):23–28.

———. 1988. Economics, equity, and sustainable development. *Futures* 20:598–605.

Postel, S. L., and B. H. Thompson, Jr. 2005. Watershed protection: Capturing the benefits of nature's water supply services. *Natural Resources Forum* 29:98–108.

Redford, K. H., and W. M. Adams. 2009. Payment for ecosystem services and the challenge of saving nature. *Conservation Biology* 23:785–787.

Ruhl, J.B., and J. Salzman. 2007. Ecosystem services and the public trust doctrine: Working change from within. *Southeastern Environmental Law Journal* 15:223–239.

Ruhl, J.B., J. Salzman, and I. Goodman. 2009 March–April. Implementing the new ecosystem services mandate." *National Wetlands Newsletter*.

Salzman, J., and J.B. Ruhl. 2000. Currencies and the commodification of environmental law. *Stanford Law Review* 53:607–694.

Salzman, J., and B. H. Thompson, Jr. 2010. *Environmental law and policy.* New York: Thomson Reuters/Foundation Press.

Salzman, J., B. H. Thompson, Jr., and G. C. Daily. 2001. Protecting ecosystem services: Science, economics, and law. *Stanford Environmental Law Journal* 20:309–332.

Sax, J. L., B. H. Thompson, Jr., J. D. Leshy, and R. H. Abrams. 2006. *Legal Control of Water Resources.* St. Paul, MN: Thomson/West.

Sohn, L. B. 1973. The Stockholm declaration on the human environment. *Harvard International Law Journal* 14:423–515.

Stephan, M. 2002. Environmental information disclosure programs: They work, but why? *Social Science Quarterly* 83:190–205.

Tallis, H., P. Kareiva, M. Marvier, and A. Chang. 2008. An ecosystem services framework to support both practical conservation and economic development. *Proceedings of the National Academy of Sciences* 105:9457–9464.

Thompson, B. H., Jr. 1996. Environmental policy and state constitutions: The potential role of substantive guidance. *Rutgers Law Journal* 27:863–925.

———. 2000a. Tragically difficult: The obstacles to governing the commons. *Environmental Law* 30:241–278.

———. 2000b. Markets for nature. *William and Mary Environmental Law and Policy Review* 25:261–316.

———.2002. Conservation options: Toward a greater private role. *Virginia Environmental Law Journal* 21:251–315.

———. 2006. The environment and natural resources. In *State constitutions for the twenty-first century: The agenda of state constitutional reform,* ed. G. A. Tarr and R. F. Williams: 307–339. Albany, N.Y.: State University of New York Press.

———. 2008. Ecosystem services and natural capital: Reconceiving environmental management. *New York University Environmental Law Journal* 17:460–489.

———. 2012. Ecofarming: A realistic vision for the future of agriculture?" *UC Irvine Law Review* (forthcoming).

Tietenberg, T. and L. Lewis. 2008. *Environmental and natural resource economics.* Boston: Pearson/Addison Wesley.

U.S. Environmental Protection Agency. 2006. *Ecological benefits assessment strategic plan.* Washington, DC: U.S. EPA. http://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0485-01.pdf/$File/EE-0485-01.pdf.

U.S. Environmental Protection Agency Science Advisory Board. 2009. *Valuing the protection of ecological systems and services.* EPA-SAB-09-012. Washington, DC: U.S. EPA.

Victor, D. F., and J. C. House. 2004. A new currency: Climate change and carbon credits. *Harvard International Review*, 26(Summer):56–68.

Wathern, P. 1988. *Environmental impact assessment: Theory and practice.* London: Routledge.

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Seminar

1

Background and History: Ecosystem Services

Speaker

Barton H. “Buzz” Thompson, Jr.

2011 ECOSYSTEM SERVICES SEMINAR SERIES

GORDON AND BETTY MOORE FOUNDATION

Ecosystem Services Seminar 1: Background and History: Ecosystem Services Presentation

Presentation and Discussion Notes from Speaker Barton "Buzz" Thompson Jr.

Seminar Series and Seminar 1 Goals:

The goal of the multi-session seminar is to educate funders and the broader conservation community on many different aspects of ecosystem services – such as how to account for ecosystem services and to effectively measure, manage, and communicate them.

Seminar 1 focused on the following goals:

- *Introduce Ecosystem Services and explore the history of ecosystem services as an approach to conservation*
- *Trace the development of the concept and provide perspectives on what distinguishes ecosystem services from traditional conservation interventions*
- *Give an overview of the economic, ecological, and policy rationales for ecosystem services*

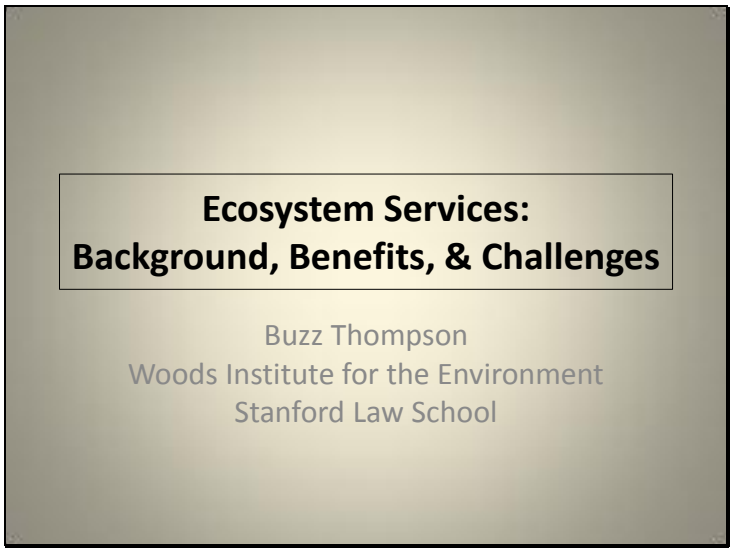
Disclaimer:

This document is a summary that includes PowerPoint slides from the speaker, Mr. Barton "Buzz" Thompson Jr., and notes of his talking points. In addition, we provide a synthesis of important questions discussed during Seminar 1. Please keep in the mind that the following document is only a recap of Buzz's presentation and Blue Earth Consultants' notetakers have, to the best of their ability, captured the speaker's presentation. We hope that the following presentation and discussion notes will be used as resource to advance further discussions about ecosystem services.

GORDON AND BETTY MOORE FOUNDATION

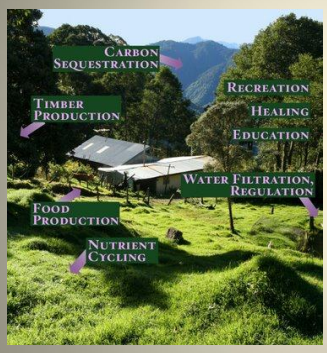
COASTAL QUEST

BLUE EARTH CONSULTANTS



Presentation Goal:
This presentation will cover a great deal of territory to set up and prepare the audience for the seminars.

Four Topics



1. **Why Do We Need Environmental Regulation?**
   - **Alternative frameworks**
2. **Traditional Regulatory Approaches**
3. **What Do Ecosystem Services Add or Change?**
4. **Challenges to the Use of Ecosystem Services**

This presentation addresses the following four topics:

- Why do we need environmental regulation?
  - We use it to address market failures.
- How do we currently approach problems?
  - We use regulatory approaches.
- What do ecosystem services add to our traditional toolbox or change?
- We will touch on some challenges to the use of ecosystem services, but this is something that will be addressed in later sessions.

Three Frameworks for Environmental Regulation

- **Market Failures**
  - **Neoclassic economics**
- **Environmental Rights**
- **Cognitive Errors**

Why does the environment not protect itself?

There are three different frameworks to justify why we step in to protect the environment.

Environmental debates stem from people approaching these issues by using different frameworks.

Framework 1 – Market Failures

The market fails. In the case of the environment, the market cannot help determine where development should be; when you talk about the environment and ecosystems, the market fails.

Why does this happen? Market fails for 4 reasons.

Reason 1

- **Environmental Goods are Public** – They are nonexclusive and non-rivalrous.
  Ex: The Amazon and carbon sequestration; to the degree the Amazon is absorbing carbon, we all benefit. The market does not exclude anyone so THE MARKET DOES NOT PRICE PUBLIC GOODS. No one will protect the good because the thinking is that there will always be someone else who will protect the good.
  Ex: wildlife area rich in biodiversity – few people protect it because other people will. The idea is again that someone else will do it.

Reason 2

- **Tragedy of the Commons** – resources are open for everyone to use
  This is cultural issue. In most cultures, but not all, resources tend to be overused i.e. open-access fisheries and groundwater (over pumping of ground water)

Reason 3

- **Negative Externalities** – the previous two reasons are both negative externalities.
  Ex: If I am pumping ground water out for my agricultural use, I am also causing harm by lowering the water table or leading to subsidence or shortages, but I only suffer a portion of that cost. I get all of the benefits and only a disproportionate amount of the cost. This leads to overconsumption because I do take on all of the costs.
  Ex: Similar scenario exists in the Amazon – If I cut down the trees, I get all the benefits and the harm is put on others, not myself.

Reason 4

- **Collective Action Problem** – If we come together as a group and develop regulations, it will be more beneficial for all, but it is time consuming and difficult; the temptation to let other people solve the problem is strong: FREE RIDER PROBLEM - This is the traditional economic explanation of why we need regulations. The Market does not work well in this situation.

Ecosystem services fight nicely into neoclassical framework, if you can value them and show people how they will benefit.

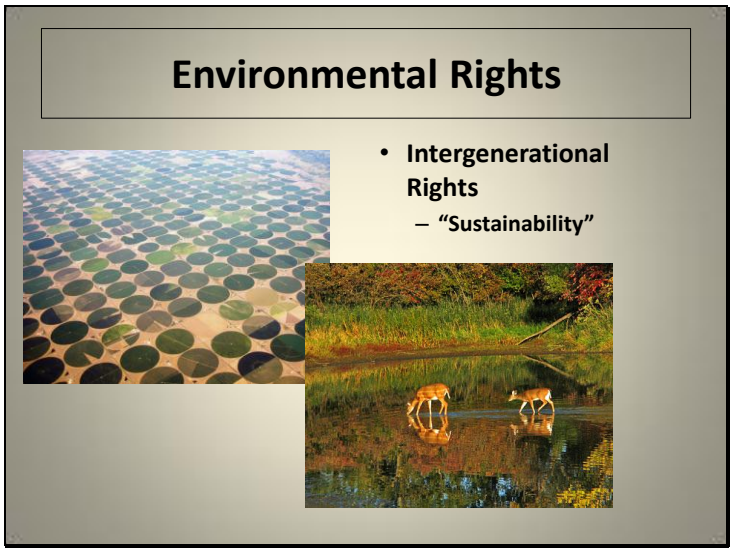
Framework 2 – Environmental Rights
We value environmental protection. This is the belief that we need to step in and protect it whether the market does or does not works.

Even if we are not willing to pay for it, a lot of us still think environmental protection is important. There is an ethical/human right component.
We see this is a lot of international instruments and in national and state constitutions
Ex: In US, the state with the strongest environmental right is Montana. In the 1970s, they revised their state constitution. In the revisions, they provide that everyone has a right to a healthy environment and that the state must manage its resources on a sustainable basis.
Note that this was NOT ABOUT ECONOMIC FAILURE.

Environmental rights not only reject economic reasoning, they move beyond human preferences, i.e. other living creatures have rights; this is a bio-centric view!
What about the rights of the environment, beyond humans and animals? This is an eco-centric view!

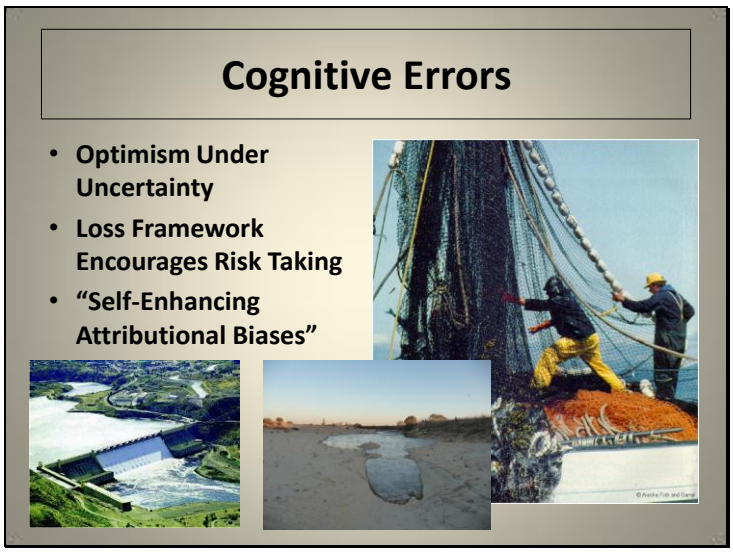
This framework argues that when we look at the environment, we do not and should not value it based on monetary/economic values, but on INTRINSIC values.
It has value beyond what I say it does…the values go beyond one person.

Members of this framework are troubled by ecosystem services because comes out of an economic framework and not intrinsic environmental rights theory.



This framework is not just about protecting the environment for today, but also about protecting it for future generations.

This theory may be more coherent as a theory in the future generation context than in the economic sustainability sense.



Framework 3- Cognitive Errors

Even if we think rationally, we engage in a variety of cognitive errors that make it difficult to address issues relating to the environment.

Let's use the fishing context to illustrate this…

Cognitive Error 1:

- **Optimism Under Uncertainty**
  In conditions of uncertainty, we tend to be overly optimistic.
  Ex: If you tell fishermen we are running out of fish and give them an estimate rage A-B, the fishermen will think the stock is at the top of the range at B. They think the situation is better than it really is.
- Psychologically, people tend to be optimistic when they hear about catastrophe.

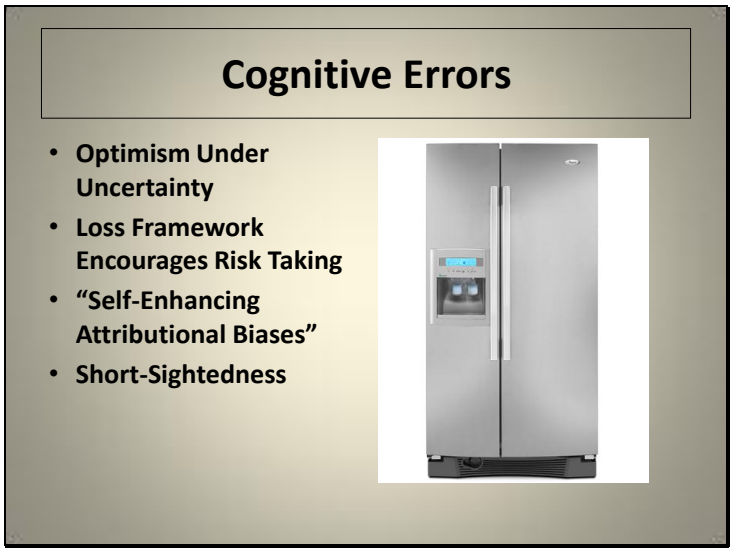
Cognitive Error 2:

- **Loss Framework**
  People can be placed in 2 categories depending on the loss framework: risk-taking and risk adverse
  Ask them to give something up they become more willing to task risks than they normally would
- Ex: Two best situations
  - I will give you $50, or alternatively, I'll give you the following bet: We will flip a coin. If it lands on heads, you get $100. If it lands on tails, you get nothing at all. Would you rather have $50 certain or risk for $100? **Most people tend to be risk adverse** and take the $50 certainty.
  - In this situation, you either have to give me $50 or you have to take the same bet described above. In this situation, more people will take the bet. **To avoid a loss, people will take a risk**.

  This is what is happening in the fishing context. i.e. you have to give up some of your quota today to get something later that is uncertain. Instead of giving up their quota now, fishermen are taking the chance in the future so they don't have to give up anything now.

Cognitive Error 3:

- **Self-Enhancing Attributional Biases**
  This is the rationalization that if there is a problem, it's not my fault; it is the fault of something else. I.e. the decrease in fish is not because of fishing, it's due to the dams, and/or lack of water….Anything really, as long as it's NOT MY FAULT



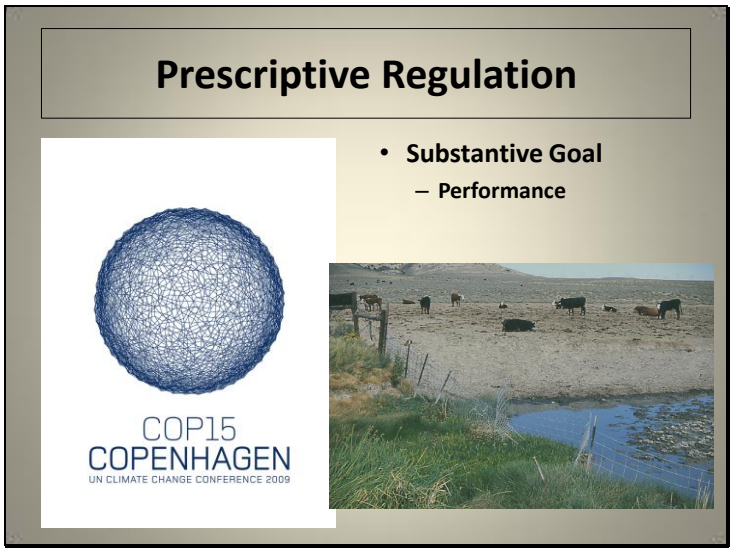
Cognitive Error 4:

- **Short-Sightedness**
  As humans, we are short-sighted. We want results right now. People focus on immediately price rather than future savings.
  Ex: We will be the fridge with the cheapest price right now. It doesn't matter if the Return on Investment (ROI) is large; people think about the short-term savings instead of the long-term savings.

Traditional Regulatory Approaches

- **Prescriptive Regulation**
  - **"Command & Control"**
- **Property Rights**
  - **"Free Market Environmentalism"**
- **Financial Incentives**
- **Direct Protection**
- **Persuasion**

- **Prescriptive Regulation:** Traditional regulatory approach has been prescriptive regulation with a "command and control" type of process.
  Ex: The Supreme Court reducing emissions in Massachusetts.
- **Property Rights**
  Traditional neoclassical solution; response to tragedy of the commons scenario. The belief here is that property rights will solve problems.
- **Financial Incentives**
- **Direct Protection-** incentive – Such as the Nature Conservancy's work.
- **Persuasion**
  Our traditional regulatory approaches with taxes and penalties etc…



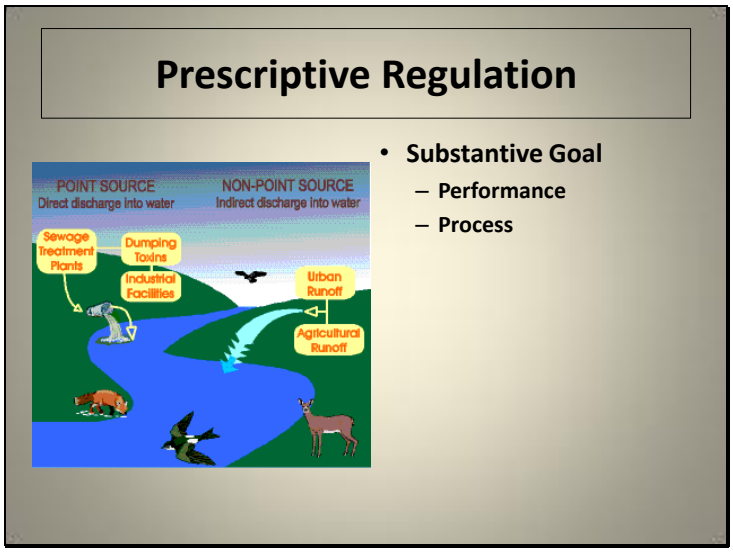
There are a variety of ways we regulate the environment:

- **We Set Substantive Goals**; sometimes they are performance goals
    - Kyoto protocol countries have performance standard that they are supposed to meet.
    - Under Federal Land Management Act, we are supposed to manage federal lands for multiple sustained yields.

- **Greater Focus on Health than Ecology:**
  A lot of our environmental laws have been more focused on human health than they have been on ecology or ecological health. The reasoning has been that it's hard to tell people what our ecological goals should be. It is not as easy as telling people what our public health goals should/will be. We have more knowledge about human health than we do about ecology.
- **Ecological Goals Have Tended to Be Either:**
  - Because of this, our ecological goals are vague and not as scientifically grounded as human health goals.
  - Ex: "Multiple Sustained Use" is vague compared to health standards.

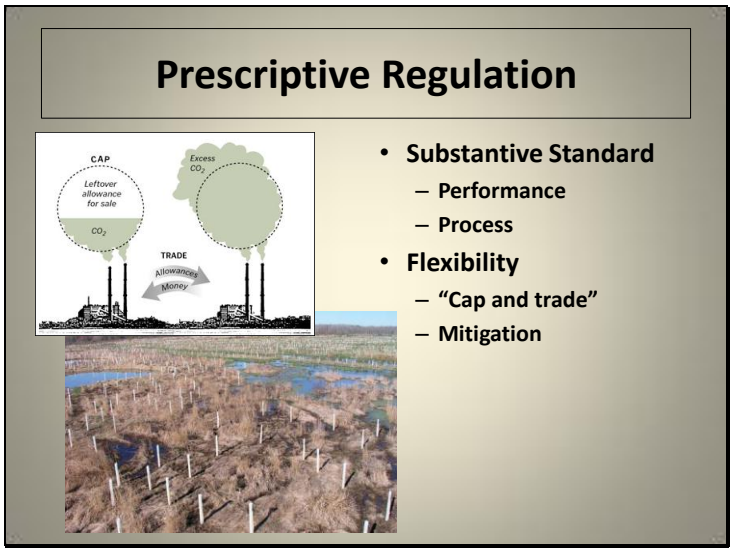
- **Goals are Static** – we set them and don't revise them

- All of these are failures in terms of long-term sustainability of our environment.



- **Substantive Goal:** We regulate process rather than a substantive performance goal.

- In picture, we don't regulate agricultural runoff, probably for political reasons, we use process regulation - Best Management Practices (BMPs)
  These too are still fairly vague goals.

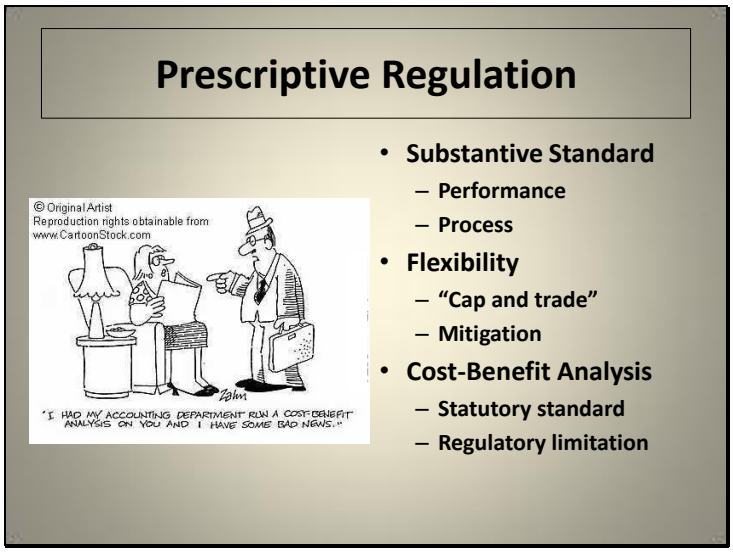


- **Flexibility:**
  We have tried to find ways to introduce flexibility.

  Business and property owners complained that regulation was too costly, so we attempt to be more flexible.
  "Cap and trade" Cap is our performance standard, this is not an alternative to prescriptive regulation, it is simply a means to make it more flexible!
  We permit trades for flexibility.

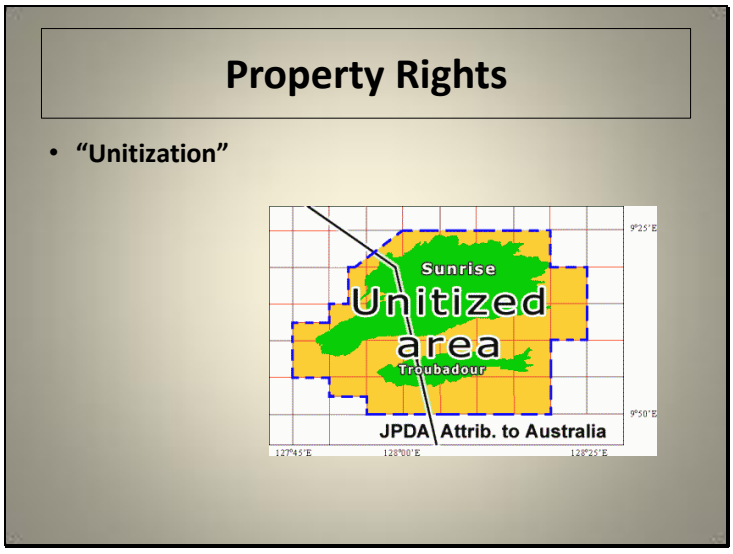
  Mitigation is another to we use to increase flexibility.

  Section 404 Clean Water Act – we permit people to destroy wetland if they have compensatory wetland protection elsewhere. More later…
  THIS IS FLEXIBILITY!



- **Cost-Benefit Analysis.**
  It terms of statutory standard – prescriptive regulation in US and elsewhere use Cost-Benefit (C-B) analysis; improve environment to a point where benefit outweighs the cost

  In US, we require our agencies to engage in cost benefit analysis to regulations they wish to impose.
  Congress says that we should not impose regulation unless the benefit outweighs the cost.
  Again, this is an economic mindset for thinking about environment.



- **Unitization**
  We use property rights and unitization to try and protect environment and improve its use.

  Ex: Oil and Gas
  Oil is a common good in the sense that anyone overlying the ground can pump it out. In the picture, this is an international commons issue; both countries want to pump out oil and gas. Solution – unitize the resource; let one person manage it so they don't treat it as a common

Property Rights

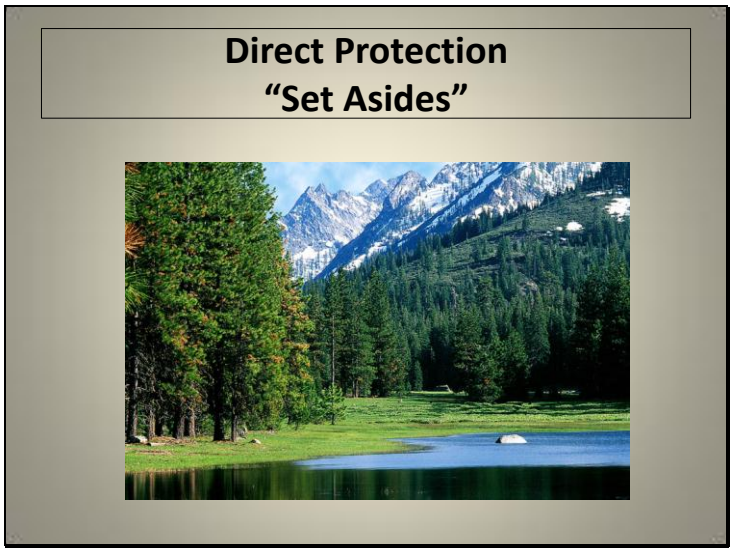
- **"Unitization"**
- **Individual Tradable Quotas or Rights**

- **Individual Tradable Quotas and Rights.**
  This is another was of using property rights.
  Ex: Fishing quotas

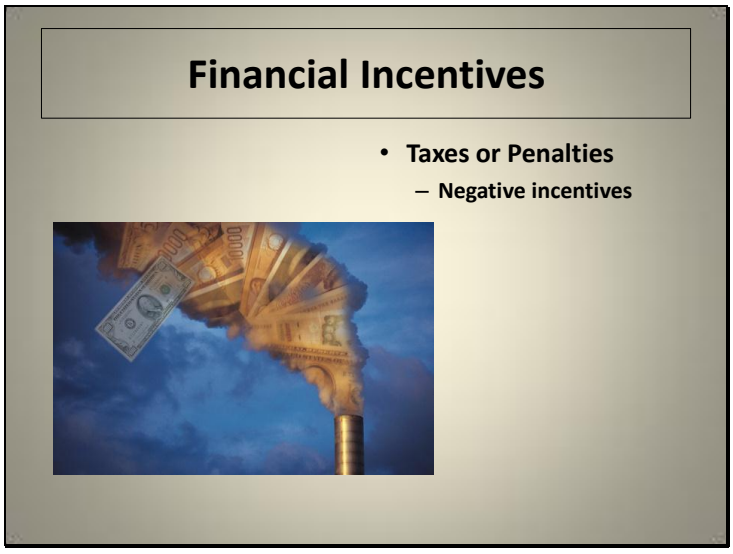
- **Privatization**

  Use privatization of the environment in order to promote protection.

  Ex: private game reserves

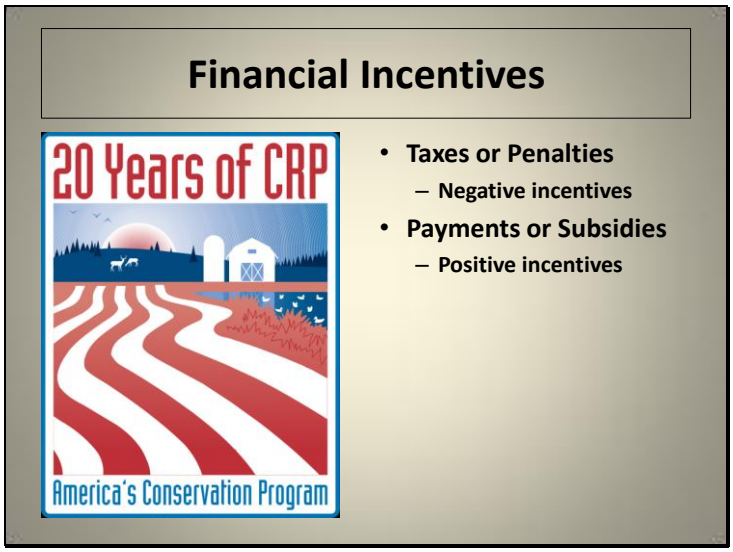


- **Direct Protection**
  In ecological area, rather than give reasons and rules to protect land, buy it and exclude humans.
  i.e. Government can acquire land and set it aside as a way to protect it OR can use tax credits to encourage conservation organizations to do it.
  Ex: conservation easements
  Ex: wilderness areas.



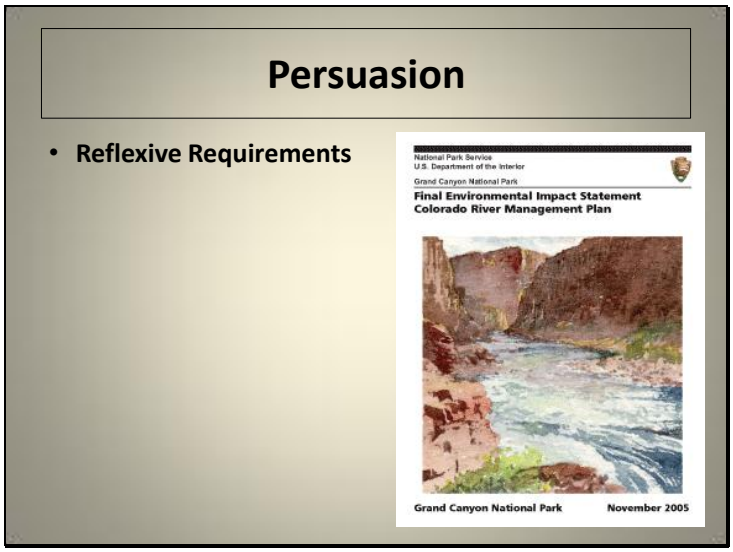
- **Taxes or Penalties** is another tool we frequently use in environmental area.

  We tax things which are bad for the environment.
  i.e. global carbon tax is an example of tax/penalty



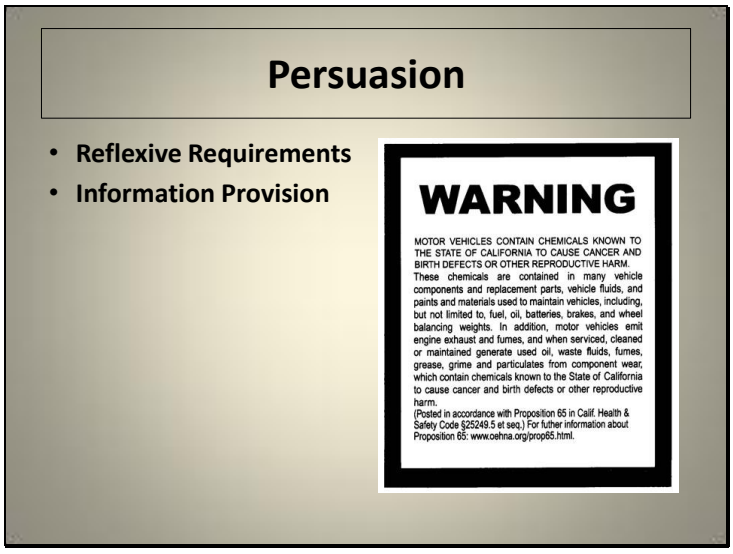
- **Financial Incentives**
  Flip side of taxation is that we will pay people to do what we what them to do.
  Ex: Federal Farm Bill. In theory, we pay people to do things that benefit environment.
  Conservation reserve program is an early example.

- **Combinations**
  We also combine penalties and rewards.
  Ex: Bottle bills: we charge people when they buy and pay them back if they bring it in.



Persuasion 1

- **Reflexive Requirements**
  One type of persuasion is a reflexive requirement
  Ex: Environmental Impact Assessment (EIA) – we force people to think about something before they do it. Assumption is that if they think about it, they may not do something that will be harmful.



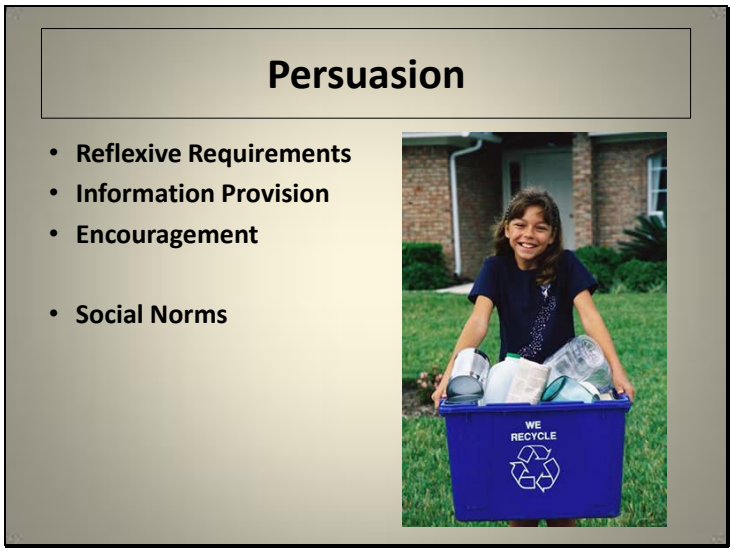
Persuasion 2

- **Informative Provision**
  We provide people with information they would not otherwise have.
  Ex: Prop 65 in California

  ASSUMPTION: with information people will do that right thing.

Persuasion 3

- **Encouragement**
  Ex: water conservation campaigns to do the right thing
  This example is from Denver, cleaver education mechanisms to conserve water.



Persuasion 4

- **Social Norms**
  The most important thing we can do to change environmental behavior is to **change social norms**.
  We have been very successful with recycling in this regard. Now, there is a norm that we recycle.

- HOW DO WE CHANGE SOCIAL NORMS?
  - Most valuable way, show people that other people are doing something.

  Ex: With recycling, the container in front of someone's house shows which neighbors are doing it. Very visible so people do it so they are not left out.
  Ex: Message on sign to not wash towels in hotel
  Message is very important: ask people to *join in* with other guests not to wash towels. You do it because other people are. You buy into social norm.

What Do Ecosystem Services Add to Environmental Protection?

"to improve and protect the forest within the reservation,... securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States."

Ecosystem services (ES) are not new!
In 1898, we created national forest in US to conserve ES, (see above quote)!
- continuous flow of water
- Timber

Though the concept isn't new, we now have a new way of thinking about ES.
Now:

- We think HOLISTICALLY!

This means we are less likely to forget one service because we look at a more comprehensive picture.

- ES play a critical role in economy and our lives.
- Because of these new emphases, we are doing more scientific research and we can now value some of these ES.
- With this new, broader emphasis, we can do more.
- ES may be able to do several things:
    - Conceptual or Political Shift-maybe can convince more people
    - Improved Goals or Standards
        - Payments for ecosystem services (PES)
    - Improved Implementation
    - Markets for Ecosystem Services (MES)-may provide a focus, and people may be willing to pay.

Many people working in the ES area think we can change how people think and convince politicians who have not been engaged in environmental participation.
Now we can talk about the environment in economic terms – which we, as a country, value and people are familiar with its jargon.

Frequently, people who aren't environmentally inclined get this way of talking about them.

ES places us in the environment. It tells us not to take ourselves out of the environment. It tells us this is what we get out of the environment.

If we think ES can provide this, how can we best communicate about ES?
Come back to in discussion

- **Refined/ Added Goals**
  ES can also help us to improve our standards by helping to refine/add to our goals.
  i.e. superfund sites
  Historically they were managed for health.
  Now, they are managed for ecological and health goals. Managers seek to answer this question: HOW CAN WE CLEAN UP THIS SITE IN A WAY THAT IS SAFE AND BENFITS THE ENVIRONMENT?

  People in the Department of the Interior are thinking about how they can take the multiple sustained yield idea and bring in the ES notions. They want to answer this question: WHAT ES DO WE GET OUT OF THIS LAND?

- **Mitigation Comparison**
  Section 404 Clean Water Act

  How do we know if restoration one site is worth destruction of another? ES can provide the currency with scientific validity to do this.

  2 years ago Army Corps of Engineers decided they could do this by looking at ES of 2 sites. Compensatory sites should be located where benefits will be most compensatory to damages done elsewhere and where similar ES are maintained or developed.

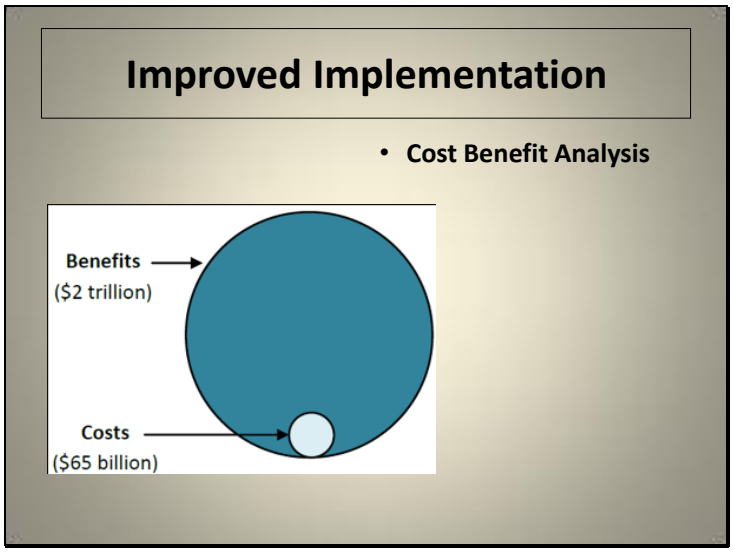
- **Incentive Payments**

ES helps our refine what we want to achieve through incentive payments. We won't be blindly encouraging activity. We can pay people to protect based on the services coming from a particular land.

Ex: Costa Rica: 1st country to setup Payment for Ecosystem Services (PES). They contracted with land owners to manage lands for 4 services

- scenic beauty
- water conservation
- carbon sequestration
- biodiversity

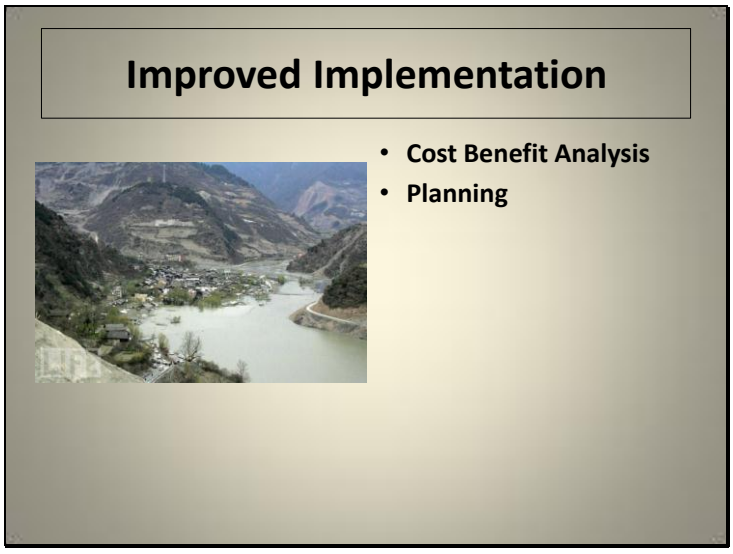
Payments are more specific because have an environmental benefit that we can measure.



ES can help us improve implementation

- EPA has to engage in Cost Benefit analysis.
  Historically EPA had a problem could tell cost but not benefits to the environment.
  Had a methodology for measuring health benefits, but no way of doing ecological benefits.

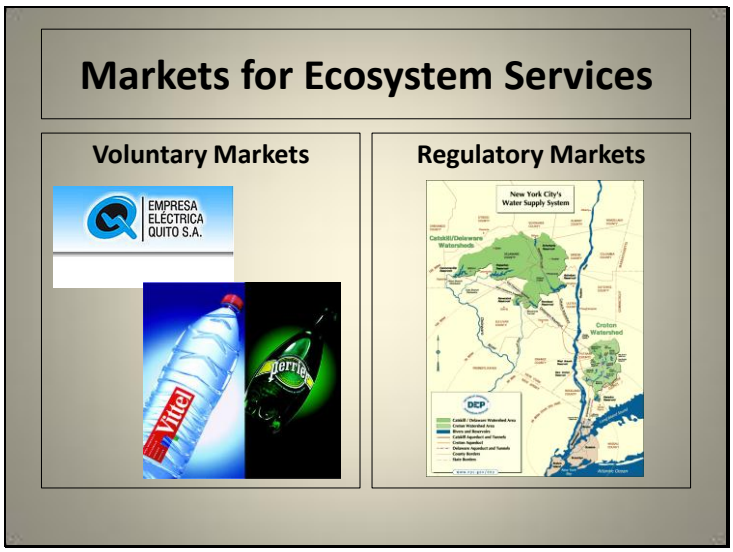
  Buzz was part of a committee to inform the EPA on how to do this; now they have a valuation mechanism similar to health evaluation.



- **ES can improve planning implementation.**

  Picture: county in China.
  China has tried to improve the rigor of their planning by increase conservation areas (20% of land area). They determined what areas we important for ES. Now they plan in those areas according to what isn't damaging to those ES. This linked up to people and gave them a rigorous tool for planning a region in order to protect environmental biodiversity, soil conservation, sand storm mitigation and flood mitigation.

  ES really helped motivate this planning. It gave them a reason: increase water yield, decrease floods.
  Gave them a rigorous concept by which they would determine where to have development and where not to have it.



We might actually have markets for ES.

People who benefit might be willing to pay for ES.

We should separate out markets.

- **People hoped we would get Voluntary Markets:**
  Although there are some examples (Empressa Electrica: hydro-electric plant around Quito Ecuador; they pay into water fund to protect watersheds; Perrier Vitell, purchase land around water to ensure water quality and pay farmers to use more sustainable less nitrate intensive methods) they are few.

- **Regulatory Markets**
  Instead, what tends to drive markets, are REGULATIONS!
  New York City Water Protection – often told as a voluntary market.
  They looked at 2 options
  1 – Building a filtration plant or
  2 – Protecting the Delaware Catskills
  What drove them to do this was the Federal Safe Drinking Water Act – it requires filtration of water or protect the upstream watershed; therefore, NY is an example of a regulatory driver.

  Virtually all examples are regulatory.

  Water markets; carbon market (driven by climate legislation)

  Significant markets are arising and they are **driven by regulation**.

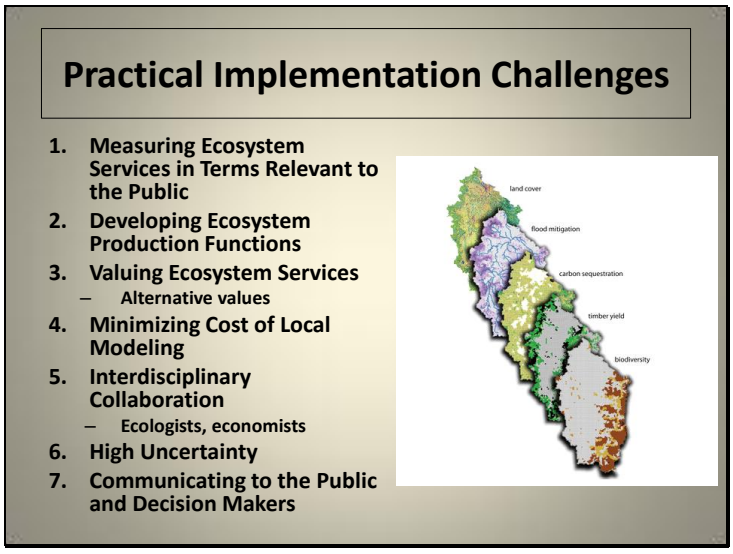
- **Commodity Markets**
  A market where ES can be reduced to something that looks like a commodity (stock or pork bellies) once you set up a market, it will work smoothly.
  Ex: Carbon emissions markets – lots of businesses are involved because it looks like something they are familiar with a traditional situation.

- However, most **ES markets are Heterogeneous**
  Local ES, which are hard to measure, are localized and very different rules will apply than those that apply to commodity markets.

  There is e a lot of potential for heterogeneous markets, if we have regulation that drives them!

- **Potential values of ES approach:**
  Drive more regulation; convince more people need to do it.
  Improve regulatory
  Drive markets

- **Challenges of Utilizing These Markets:**
  Taking ES and using them in the ways we have discussed is difficult.
  People have concerns over use.



Practical Challenges

There are more than just the 7 listed on slide.

- How do you make it relevant to people? Historically, ecologists stopped examination before getting to ES (clean water, flood avoidance, etc.).
- We need to know how a change in land use in one area will impact services in another area. We need ecosystem production functions. We need to understand policy/management alternative.
- We need to be able to value ES. How can you do it in "untraditional" ways? When Buzz sat on the EPA ES committee, thought about community level values. Different values at community level than on the personal.

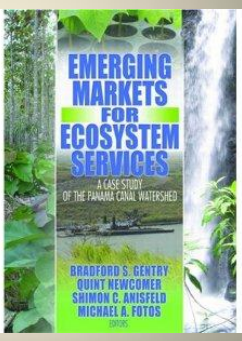
Should we look to community values as opposed to individual values?

- How do you do it at the local level with little cost? – this is difficult because
- Little collaboration exists right now
- With high uncertainty, people tend to take more risks.
- It's too hard to explain right now –

The Natural Capital Project at Stanford is trying to address these challenges

Practical Implementation Challenges: Markets for Ecosystem Services

1. **Property Rights**
2. **Collective Action Problems**
   - **Free riders**
3. **Cognitive Errors**
4. **Thin Markets**
5. **Need for "Bundling"**
6. **Monitoring Behavior**
7. **Enforcement**
8. **The "Baseline Challenge"**



- **Examples where ES market problems exist:** *(numbers in parentheses refer to numbers in slide above)*

  (1) Do you have the property rights in place? In Hawaii, how ranchers manage land in Kona might impact their ground water recharge. Maybe they can manage their land in a way to benefit biodiversity and THEIR own water recharge.
  (2) Could we get local water to pay farmers? NO! There are no property rights over water, so free rider problem.
  (4) Thin markets; few players involved
  (5)We need more than 1 service for people to get motivated. Services need to be bundled to increase the value. This type of collaboration makes things more complicated.
  (8)Why do we play people to do this? Shouldn't they do it any way, it is the right thing? Response: we think it is the right way, but not everyone does, so we need to pay them.

Variety of concerns:

- **Political and Ethical Challenges**

  ES seems to buy into neoclassic economic framework, should we put a value on nature. Doesn't this go against intrinsic value framework?

  Could it undermine direct regulation: notion here is if you can convince policy maker, then the policy maker may ask "why regulate, we can just have markets?"

  - Under the 2008 farm bill. ES were included as a creation provision; seem to hope that then people would talk less about regulating agriculture.

  Should property owners profit from increased stewardship? Is this a commoditization of ES or will it just be another?

  Should ecosystems close by benefit more than Ecosystems far away?

Potential "Adverse" Consequences

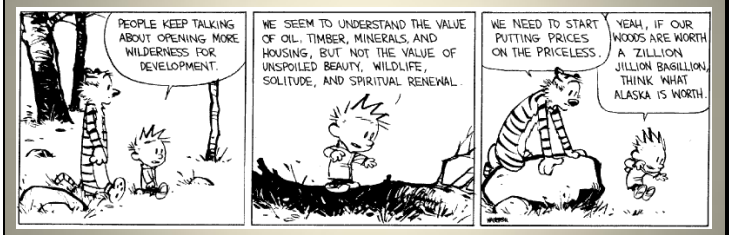
- **Conflicts between Ecosystem Services**
- **Ecosystem Services that Can Harm Humans**
  - **E.g., fires, floods**
- **Unnecessary Parts of an Ecosystem**
- **"Engineered" Ecosystems**
- **Artificial Alternatives**
- **Greater Protection for Easily Valued Services**

Adverse depends on who you are.
They way you manage it doesn't always increase all ES. THERE ARE CONFLICTS!

- Are there any unnecessary parts? Should we not protect those? Unnecessary for whom?
- What about engineered ecosystems: technological services at a cheaper rate? Should we go there?
- Some services are more easily valued than others. Some are more marketable. Does this drive the direction of ES?

WE NEED TO THINK ABOUT ALL OF THIS IN OUR DISCUSSION OF ES.

Questions?


PEOPLE KEEP TALKING ABOUT OPENING MORE WILDERNESS FOR DEVELOPMENT.
WE SEEM TO UNDERSTAND THE VALUE OF OIL, TIMBER, MINERALS, AND HOUSING, BUT NOT THE VALUE OF UNSPOILED BEAUTY, WILDLIFE, SOLITUDE, AND SPIRITUAL RENEWAL.
WE NEED TO START PUTTING PRICES ON THE PRICELESS.
YEAH, IF OUR WOODS ARE WORTH A ZILLION JILLION BAGILLION, THINK WHAT ALASKA IS WORTH.

Seminar 1 Discussion Synthesis

March 11, 2011

This document is a synthesis of important topics and questions discussed during the question and answer period immediately following Mr. Barton "Buzz" Thompson Jr.'s presentation. Please keep in the mind that the following is only a recap and speaker identities have been removed, except for Mr. Thompson Jr. We hope that the following notes and discussion questions will be used as resource to advance further discussions about ecosystem services.

Below you will find a summary of specific key questions and topics that were covered during the Seminar discussion.

Question 1

What would be the one thing to accelerate the right kind of regulation in the U.S.? What is the one thing that can drive ecosystem services markets?

MR. THOMPSON JR.

- All comes back to politics. Really, we would have to totally revolutionize our political system- but would say there are various steps we could take in our science processes; this is where ecosystem services become valuable. We can use ecosystem services to show people that the environment is relevant to them and not driving for harder standards hurts them.
- Hear a lot about cost in environmental regulation. It is easy to put a cost on regulation, i.e. how many jobs are lost etc. There is a need to make an equally good scientific case for what the benefits are for making environmental protection. That is an important aspect of ecosystem services; it allows us to do this. It does raise concerns from slide 42, but better.
- Proofiness, by Charles Seif, a book I finished recently. In short, the book says, that if you put a number on anything, then it seems more convincing. We need to do the "proofiness" for the environmental side; do the "proofiness" of environmental rights and ecosystem services. Have to put numbers on the economic values of these environmental regulations.

Question 2

How would we use climate cap and trade at the federal level? Two years ago, it looked like we were heading for a mandate that supported cap and trade. Can you explain some key issues and how we can re-approach this? What are the key things to communicate most effectively to support an overall cap and trade system in the U.S.?

MR. THOMPSON JR.

- U.S. public is more supportive of doing something in the climate sector than has been suggested. John Krosnick in Humanities and Social Sciences at Stanford has been doing surveys on climate change for 15 years. He is the best pollster around. His findings show that there has not been a "drop-off" of public acceptance in the climate area. The drop off from a year ago was largely from weather.
    - People know climate change exists, but not for the reasons scientists say. They think they know why, so they support it. They know that scientists are split but think they see it themselves. For example, if they experience a cold winter, then they start to doubt the validity of climate change.
    - People get confused about cap and trade. They think it sounds like the market, and Americans like markets, but they do not trust the market. Americans are peculiar: they live in a market economy, they like values, but do not trust the market itself. If we tell people markets are used in other contexts such as in the Clean Water Act, then their support skyrockets after that. If people understand the market basis, John Krosnick has found that there is strong support for markets.
    - Interesting fact: The state with some of the highest public support for climate change work is Oklahoma.
    - John Krosnick is doing state surveys to see if there are differences across states.
    - In addition, the Public needs to understand Cap and Trade.

Question 3

Many international organizations are thinking of ecosystem services. Even the oil industry is establishing an ecosystem services function in their companies. Why is there this push? If more and more big businesses are thinking like this will this likely push regulatory effort?

MR. THOMPSON JR.

- Why big business? Big oil companies have focused on the ecosystem services because they have lots of land and they need to manage those lands. When people have talked to oil companies asking why they are doing this, many of them say that they do not think ecosystem services markets will be big enough to bring in enough money. Instead, they chose to manage land in a way that resonates well with local community. They are looking to improve their image in terms the community understands. They can then say here is what we are doing: we are lowering flood risk, increasing water lever, etc. for you.
- Ecosystem services may be more valuable and understandable at local level because there are better connections. Water dependent companies do it to protect their interests, i.e. their water source.

Question 4

What do you think is the biggest transformative impact ecosystem services can have? Is it the creation of markets, driving investment, changing perception, companies? Government?

MR. THOMPSON JR.

- All of the various areas – bet on a combination. Bet on the combination of large government intergovernmental organizations such as, the World Bank (global level), Department of Agriculture or Department of the Interior.
- They have variety of programs right now and are looking for way to shape programs and show how they benefit the public. They all want a way to explain program that resonate with public more.

Question 5

Is there a way to keep the existing framework and redefine it to use ecosystem services?

MR. THOMPSON JR.

- Ecosystem services could is valuable at local/regional level. Example where ecosystem services is relatively effective: Chicago wilderness area.
    - Effort in that area to protect land was organized from the bottom up and talked to the public about what they thought was important and what they wanted to protect. This framed what the benefits of the land were for the community. It drove community support AND told them what was most important. Ensure that services that are most important are protected.
- Maybe we need regional or local ecosystem services plans rather than national. Generally, people benefit at local level.

Question 6

There is lots of management at a local level – very context specific but policy is at a higher scale. How do you link the local to the policy decisions at a larger scale?

MR. THOMPSON JR.

- You want a nested system. Maybe a national and state level directive to set overall goals for the local level to act and feed back up the scale. European countries have done a good job with nested government.

Question 7

Are their aspects of ecosystem services that allow us to force people to think in the long-term?

MR. THOMPSON JR.

- Actually, ecosystem services permit people to understand the value of services. I am not sure it does a lot of in the way of cognitive errors that leads us to this short-term issue. The cognitive errors mentioned in the presentation are always there. Changing social norm will be the most helpful. Ecosystem services let people know why the environment is important.

Question 8

On the Perrier-Vittel example: At scale of watershed, it looks great, but look at the Green House Gas (GHG) emissions at the larger scale, it does not look so good. Can you talk about that?

MR. THOMPSON JR.

- Here is how would talk about Perrier-Vittel: may be the worst thing imaginable for the environment, but they are not going to go out of business even if they do not protect their ecosystem.
- What is important about this example is that the business had an input (clean water) to protect. Here, natural protection was more valuable than technological protection. I would emphasize that portion of the story. Not about bottled water, but talk about business recognition of protection.
- Maybe use other examples, many of which are regulatory driven. San Francisco Example: City needed to protect its watershed and it protected area around highway 280.

Question 9:

If you think of challenges in your list (slide 41), where is more research needed to address those challenges?

MR. THOMPSON JR.

- The Natural Capital Project (at Stanford) is addressing challenges 1-5.
- I think there is an interesting question regarding alternative values. We think we need to measure in monetary terms, but what about other values? Are there other ways to measure that will be more concrete to people?
- Challenge #7 - how do you communicate in a way that is real to people and increases their support? I think visual tools are important here.
    - Example: Outside of ecosystem services- works in water issues. I have gone out to the Central Valley to discuss water issues. Now we use visualization tools that show water going down and how it is leading to subsidence and how it creates flood risk. With these new visual tools, people understand it more; it makes it more real to people than just a number
    - Many of these challenges will take care of themselves, i.e. enforcement, market issues…
- Slide 43. Someone should look into whether or not ecosystem services do undermine intrinsic value. I think you can talk to people in both terms. Does not make it seem like less valuable on economic side.

Question 10:

In South America, I have seen people get excited about valuation and they try to use it in policy, but it seems to get in the way because cost is high and it is very uncertain. What is the role of valuation in policy?

MR. THOMPSON JR.

- Do not need to be able to determine all values for all purposes. Many times not worth the cost. We need different levels of scientific tools.
    - General planning – Cost-benefit analysis may be sufficient
    - Planning tools
    - Water supply/protection - have multiple levels of tools then have better sense of when need the tool.
- Important to know that it some settings, certain tools may not make sense

Question 11:

I work in South America where there are few market economy societies. How do you use valuation?

MR. THOMPSON JR.

- It may be hard to put monetary values on ecosystem services because people do not tend to think that way. So this goes back to slide 41, when thinking of valuing ecosystem services, we should think of alternative valuation schemes. The value needs to reflect the people and community; need to speak in cultural terms of that community. If we were to testify in front of Congress, we would need to talk in economic terms because that is what we value. Other communities may not want to talk that way. They might want to talk in physical terms about the ecosystem services, i.e. water quality, water flows etc...
    - There might be different level of values– Say "these are the various ecosystem services you receive. How valuable are they? This is a 10 this is a 0." This way, the community puts it in their own terms.

Question 12:

Who is pushing ecosystem services use? Environmentalists or economists? Is not the environmental movement pushing this as a cause?

MR. THOMPSON JR.

- I think it is coming from a variety of quarters. Initially from the ecologists as a way to make ecology relevant to people in its current form.
- Actually, find now that many economists are interested in this. Next two session speakers are examples: Steve Polasky and Jim Boyd are focused on this. They are taking economic tools and merging them with ecology.
- We are hearing more and more about this from governmental agencies. They are looking for a value and a way to justify what they are doing and to see how it is benefiting people.

Question 13:

What role can ecosystem services have in connecting public health to ecological health?

MR. THOMPSON JR.

- My guess is that ecosystem services research should go where ecologists and economists have focused but where it will make the most sense for the public good if in the health sector and for health reasons. How do you do a better job at connecting the benefits of health with protecting areas?
- A few years ago, Stanford hired Eric Lambin. Link global to on ground studies. He works to link land-use with disease factors and determine the interplay between both. There are two reasons why we have been focused on health: 1) we did not have the ecological tools to connect to health and 2) psychological: people care about personal health and is it something that they talk about so we can connect to it. Making the link between ecology, economists, and public health would be great.

Question 14:

Is there an ecosystem services "deniers" camp?

MR. THOMPSON JR.

- Most criticism I have heard is from environmental side rather than business side. They are not really "deniers" but they are doubters. The thought goes like this: "is this another environmental organization method to come up with argument? How important are these ecosystem services when get down to it?" Used to think bio-prospecting was going to save the forest – it did not get us there.
- We need to use what is most likely to resonate.
    - Example: Pollination services - does not sound substantive, it will not get us there

Question 15

How do you appeal to people's values if they are an ecosystem services denier? Some want job values, some want economic values, some want other values. There may be a difference between local decision and national priorities. Pitfall may be that a group values destruction of an area. Do we need to have some national standard to push back?

MR. THOMPSON JR.

- True to the degree if you have an area where focus is just on ecosystem services and people do not worry about future generations. If you make inter-generational, people will value it differently. Do not focus exclusively on ecosystem services. Ecosystem services are not in conflict with environment rights, so you can emphasize both.

Question 16

I am trying to make the connection about cognitive errors. I work on climate change and cognitive errors are a real issue. Why do we not have comprehensive legislation? How do you link up and work in concert and address cognitive errors and political pieces in parallel?

MR. THOMPSON JR.

- I have not really thought about that question. I do not think ecosystem services by themselves get us over cognitive errors. There are other tools to help us with that. Self-enhancing attributional biases can help: gather people together and they see they are part of the community are involved.

Question 17

In CA, we have a compliance market – is the carbon market an anomaly?

MR. THOMPSON JR.

- The carbon market is anomalous in that it is a commodity market and that it is a global market. However, there are other options; commodity markets are just one possibility. Hydro markets are probably the next ones to have a lot of money and potential.

On Transparency

- Level of transparency will create readiness impacts.
    - British Petroleum spills oil and the impact is seen on the London stock exchange immediately.
    - Some day when consumers care about product differences it will become apparent. Consumer understanding will increase as transparency increases and externalities are included.
- If can set production functions that are transparent and easy to understand then you can get to something and people will make tradeoffs. Here, the data needs to be fast.
    - Example: When companies needed to disclose toxins released to community, they dropped 60%. This disclosure had the biggest impact of any regulatory decisions. Power and information moved it quickly.
- My dream is that when a shopper goes into a Wal-Mart in 20 years, the lowest cost shirt will be the one with the lowest impact rather than being the one with the most harm.
- We have to explain to community what money is for; need to explain use and reason.

On Reporting

- Could use Ecosystem services to track and report gains such as what taxpayers are receiving from farm bill at a watershed or regional scale. Then can make a united way style campaign of preservation. Switch from reporting and staying below a threshold, to a positive reporting mechanism. Conservation planning can start by pulling planning docs off the shelf to meet goals.
- When went to community in Sonoma County and talked about recreation, public health, and flood control, etc. there is a high level of interest, people get it. We need to quantify level to date and ask for more funding and do more of this. Show that the water agency and parks district are working together in integrated fashion and ask that they support us and avoid large capital projects and send fund to small-scale protection with less impact.

On Biodiversity

- Define shifting perspectives. In some situations, you might maximize Ecosystem services spatially, but not biodiversity. What does that mean for biodiversity? Spatial targeting will be key in how conservation projects are done.
- We realized Santa Cruz County is one of the most environmentally lenient. However, they have a constituency that has been very successful in water and land conservation but they are in silos. Overall, it appears to have high success, but also have 18 impaired watersheds that are under the radar of water control board, and have many issues. Through a project I worked on, this was the first time that people had thought about it in this way or that way; it was the first time people questioned the normal way of work. When we stopped only looking at biodiversity, we found there were other holistic reasons for protection.

On Making Changes

- One challenge in thinking of investments is that we are at a key decision point. 1) There is a lot of opportunity to move language and conceptual approach into use and 2) to develop tools to do the measurements. Problem is that, in oceans, you are lucky if you get data every three years let alone yearly or on a smaller scale.
- I tis important that we do not hang ourselves by waiting on the science. Linkages and three above things will not move at the same pace. We need more tools today to help make decisions without the full data.
- Why was this not operationalized in multi-use? Groups value things differently. Those with more power get their views imbedded into the system and society than those with less.
- Why is agricultural runoff not regulated the same way? Because they have the power.
    - Some people do not care about what happens in the Gulf. They know it is happening but they want high agricultural production. You can go on valuing how you want but you have to make a decision about whether you want or need to make a behavior change. May get a "no" answer.
- Talk about it all you want but it is a political process and the political process will be governed by concentrated political groups and change that process.
- Wal-Mart buys most agriculture products. To change paradigm among farmers, get them to stop being able to sell everything through Wal-Mart.
- The key point is that a Lee Scott is one of a handful of leaders at Wal-Mart. There are social norms among CEO and companies; they pay attention to each other and want to match what others are doing.
- Perhaps matter of changing the marketplace.

On Being an "Environmental Movement"

- Before. The philanthropic world worked on Colorado River in desert South West. Not willing to make change until showed that tamarisk was pulling too much water. Only then could we get backing to do Ecosystem services analysis. Then started working with irrigation, and semiconductor people would get involved as long as not articulated as having an environmental goal. Will not get adoption and uptake from others even if we demonstrated the financial return just would not get there from the environmental side.
- After Millennium Ecosystem Assessment, spoke with people from the Hoover Institute who would be willing to work with them on this as long as it did not mean talking about the environment; make it about human well-being and not the environment.
- Ecosystem services will require a huge philosophical shift.

On Catastrophe as a Catalyst

- In South America, after having the largest flood in Columbia's history, they are thinking of land zoning and deforestation. The warning is that, are going to wait until we suffer that large-scale damage to make a change? Answer is yes.
- Catastrophes have an amazing way of motivating reform. How do you get change without the disaster?
- Most change happens out of catastrophe or some big lever. Can ecosystem services overcome other kinds of leverage like catastrophe and other motivations of change? Where can we put leverage on the system?
- If you do not wait for the catastrophe but if you show where else it has happened, it helps people relate at a visceral level and make changes.
- I am curious about Columbia's response with ecosystem services; are they in one country or transboundary?
    - Last week there was an agreement in Brazil and Columbia to make regulation of watersheds. Brazil wants more hydro. Their motivation is based on energy; Brazil will export energy back. What is relevant to public? When we look at Brazil, all headwaters in Andes.

On Integration

- How do you develop framework that allows you to integrate? How do you show value of ecosystem services when the ecosystem services are not valued? How do we actually take frameworks to the folks who need it?
- One thing you emphasize is the problem of scale. Who generate the ecosystem services and who is using them? Particularly when there is an international division of this.
- The people I interact with are in developing communities and what you put in your presentation is that there is a language that brings people together and allows them to discus. Maybe devised terms can be put on the sideline. The interest is there; it is in the readings. The interest is there but something productive needs to come out of it to keep that interest.

Seminar

2

Theory of Ecosystem Services

Speaker

Dr. Stephen Polasky

GORDON AND BETTY MOORE FOUNDATION

Valuing Nature: Economics, Ecosystem Services, and Decision-Making

by Dr. Stephen Polasky, University of Minnesota

INTRODUCTION

The past hundred years have seen major transformations in human and ecological systems. There has been a rapid rise in economic activity, with a tenfold increase in the real value of global gross domestic product (GDP) (DeLong 2003). At the same time, the Millennium Ecosystem Assessment found many negative environmental trends leading to declines in a majority of ecosystem services (Millennium Ecosystem Assessment 2005). A major reason for the rapid increase in the production of goods and services in the economy and deterioration in the provision of many ecosystem services is the fact that market economic systems reward production of commodities that are sold in markets and accounted for in GDP, but does not penalize anyone directly for environmental degradation that leads to a reduction in ecosystem services. As Kinzig et al. (2011) recently wrote about ecosystem services: "you get what you pay for" (or, alternatively, you don't get what you don't pay for).

Ecosystems provide a wide array of goods and services of value to people, called ecosystem services. Though ecosystem services are valuable, most often no one actually pays for their provision. Ecosystem services often are invisible to decision-makers whose decisions have important impacts on the environment. Because of this, decision-makers tend to ignore the impact of their decisions on the provision of ecosystem services. Such distortions in decision-making can result in excessive degradation of ecosystem functions and reductions in the provision of ecosystem services, making human society and the environment poorer as a consequence. Unless we fix this imbalance and begin to properly account for ecosystem services, and provide proper incentives for their sustainable provision, global society is unlikely to see the type of fundamental change necessary to sustain environmental quality, ecosystem services, and human well-being.

The question is how to remedy this situation and make ecosystem services visible to decision-makers. How can we "mainstream" ecosystem services so that individuals, businesses, and government agencies factor in the impact their decisions have on ecosystem services? In principle, the answer is easy; it lies in providing incentives for people to provide services, either through programs that provide payments for ecosystem services, or through taxes on actions that lead to environmental degradation, or by directly regulating activities that affect ecosystem service provision. In practice, there are numerous scientific uncertainties about the impact of choices on the provision of ecosystem services, economic uncertainties about the relative values of services, and institutional and policy design considerations. The three main tasks that must be performed in order to successfully mainstream ecosystem services are to:

1) Link actions to impacts on the ***provision*** of services: improve understanding of the likely consequences of human actions on ecosystem processes and of their ultimate impacts on the natural capital that sustains ecosystem services
2) ***Value*** services: improve understanding of the contribution of ecosystem services to human well-being
3) Provide ***incentives***: incorporate an understanding of the value of ecosystem services into policy and management frameworks, to provide incentives for the continued provision of valuable ecosystem services

Accomplishing these three tasks requires a better understanding of the natural science involved, better economic analysis, and better integration of science and policy. In some respects these tasks represent a tall order, and it may not be possible to be successful in all situations. But in many cases the policy tools and scientific knowledge are already in place. Doing a much better job than is currently being done is simply a matter of deciding that mainstreaming ecosystem services is a high priority. This white paper provides a brief review of the policy mechanisms, science, and economics relevant to the sustainable provision of ecosystem services. It provides examples of the use of InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) to evaluate the provision and value of multiple ecosystem services provided by landscapes under alternative policy scenarios.

There are a growing number of examples at both local and national scales of policies that provide incentives for the provision of ecosystem services. In the U.S., agricultural programs like the Conservation Reserve Program pay farmers to take land out of active crop production and plant perennial vegetation in order to reduce soil erosion, improve water quality, and provide habitat and other ecosystem services. Similarly, China's Grain for Green program pays farmers to take steeply sloping lands out of production to provide a range of ecosystem services. Costa Rica's Pago de Servicios Ambientales pays landowners for carbon sequestration and to protect water quality, biodiversity, and scenic beauty.

At the local level, numerous municipalities provide payments to protect watersheds that supply drinking water. The success of an early program in Quito, Ecuador, that collects a small surcharge on water users to protect and restore watersheds has led to the rapid spread of "water funds" throughout Latin America. Private companies are also looking at how ecosystem services affect their bottom line. Dow Chemical Company and The Nature Conservancy have embarked on a joint project to assess the value of ecosystem services to Dow and surrounding communities.

Some conservationists and natural scientists have expressed grave doubts about "valuing nature" and ecosystem services, as well as the role of economics and economists in conservation and environmental policy. Some scientists have complained that economists pay almost no attention to biological or physical constraints (Hall et al. 2000), and that economists are hooked on growth and therefore enemies of conservation and the environment (Czech 2000). Others have argued that working with economists to value nature is either distracting or dangerous, because it plays into the hands of business interests and takes away from the strong moral arguments for conservation (e.g., Ehrenfeld 1988; McCauley 2006). But most conservationists and natural scientists realize that engaging with economists to demonstrate the value of nature, and how ecosystem services contribute to human well-being, can provide powerful arguments for the conservation of nature (Daily 1997; Millennium Ecosystem Assessment 2005). In fact, continuing to put no value on ecosystem services will likely continue the pattern of overexploitation and environmental degradation that we have witnessed in the 20th century.

Many economists, including several who are high-profile, such as Nobel laureate Ken Arrow (Arrow et al. 1995, 2004) and Sir Partha Dasgupta (Dasgupta 2001), have applied economics to environmental issues and have developed economic tools and methods applicable to addressing the value of nature. Economics is an essential component of efforts to measure the provision and value of ecosystem services, and to understanding how mechanisms to mainstream ecosystem services are likely to work in practice. A fully developed economics should routinely incorporate the value of ecosystem services into its analyses. It is bad economics as well as bad policy not to account for the value of nature.

HISTORICAL AND METHODOLOGICAL FOUNDATIONS OF ECOSYSTEM SERVICES

Though the term ecosystem services is fairly new — among the first uses appears to be Ehrlich and Mooney (1983) — the idea is quite old. Throughout most of human history, it was probably so obvious that nature contributed to human well-being as to be totally unremarkable. Both hunter-gatherer societies and agricultural societies are clearly tied to the functioning of ecological systems, even if these systems are heavily modified in agro-ecosystems. It is only with increasing wealth, supporting specialization and the rise of urban populations, that the most obvious ties to nature have been cut. And though we might like to think that overpopulation, pollution, and the overuse of resources are modern problems, concerns about them go back at least to the Greeks and Romans, if not before. For example, the following quote is from Roman times:

> "…farms obliterate empty places, ploughed fields vanquish forests, sandy places are planted with crops, stones are fixed, swamps drained…. The resources are scarcely adequate to us; and our needs straiten us and complaints are everywhere while already nature does not sustain us." — Quintus Septimus Florence Tertillianus 200 AD (quoted in Johnson 2000).

Concerns about human demands exceeding what nature could supply are present in some the first contributions by economists. Thomas Malthus famously wrote that population, when unchecked, grows geometrically, while food supply grows arithmetically, so that eventually demand for resources outstrips their supply. According to Malthus, starvation and disease would ultimately check human population. For such thinking, economics gained distinction as "the dismal science." Another early economist, David Ricardo, derived the theory of rent and diminishing returns by observing that the best agricultural land would be utilized first and that further expansions of agriculture would be forced to use less productive land.

Much of the theory underlying modern economic thinking about the environment was developed in the 19th and early 20th centuries. Optimal use of natural resources has been a recurring theme in economics. Martin Faustmann solved the problem of the optimal rotation age for timber harvests in 1849. Harold Hotelling described the optimal use of exhaustible resources such as oil or mineral deposits (1931). Perhaps the most important advance for understanding the problem of providing incentives to preserve ecosystem services came from British economist A.C. Pigou (1920) who developed the notion of externalities, where the actions of one individual or firm directly impact the welfare of other individuals or firms.

Negative externalities involve actions by one party that directly harm other parties, like emitting pollution, but for which the first party pays no cost. Positive externalities involve cases where the actions of one party directly benefit other parties, but the first party receives no payment. Unless some type of corrective policy is undertaken to "internalize" the externality, too many negative externalities and too few positive externalities will occur. Pigou recommended that actions generating negative externalities be taxed (now called Pigouvian taxes) and actions generating positive externalities be subsidized. Payments for ecosystem services can be thought of as one form of Pigouvian subsidy.

Currently there is a vast body of work by economists relevant for thinking about the value of ecosystem services. Much of this work lies in the fields of environmental economics, natural resource economics, and ecological economics. Environmental economics builds on the Pigou's insights to analyze problems caused by externalities and public goods. Public goods are "non-rival" (one person's enjoyment of the good does not diminish the ability of others to enjoy the good) and "non-excludable" (if the good is available for one it is available for all). Many ecosystem services are public goods — for example, water purification or climate regulation services. Public goods are typically under-provided because there is an incentive to free-ride: why pay to provide a public good when you can freely enjoy the good provided by others?

Environmental economists have also developed a range of policy approaches to internalize externalities and provide incentives for the provision of public goods, including payments for ecosystem services, taxes on pollution and other negative externality–generating activities, and cap-and-trade systems, which limit the overall level of a negative externality–generating activity but allow entities to trade permits that entitle them to engage in that activity. This topic is by now quite well developed, with many textbooks describing alternative policy mechanisms that could be applied to internalize externalities and provide public goods (e.g., Hanley et al. 1997; Tietenberg and Lewis 2009).

In addition, environmental economists have developed methods of nonmarket valuation. Most ecosystem services are not traded in markets and so have no market prices to act as a signal of value. Nonmarket valuation uses observed behavior, such as how much more people pay for houses near environmental amenities, where they travel for outdoor recreation, and responses to survey questions, to gauge the value that people place on environmental quality or other aspects of nature. Nonmarket valuation began to be applied to what we would now call ecosystem services in the 1960s and 1970s, in work centered at Resources for the Future (Krutilla 1967; Krutilla and Fisher 1975).

Natural resource economics and ecological economics address sets of issues related to human–nature interactions and sustainability. Natural resource economics analyzes the use of renewable and exhaustible resources, and has been applied to analyze other "resources," including aspects of nature (species, habitats, natural beauty), that are important for recreational and spiritual or cultural reasons. Reflecting this, some economists have begun to use the term "ecosystem services" rather than "natural resources" to discuss the broad set of ecosystem contributions to the generation of benefits for people. Natural resource economics is useful for those interested in ecosystem services because it has developed integrated bioeconomic models, particularly for fisheries, that help link ecological conditions with provision of services. Such models are also useful for analyzing the sustainable provision of services, and how overharvesting or degrading natural capital would lead to a lower supply of services in the future. These models laid the groundwork for the "ecological production functions" used in ecosystem service models.

The central theme of ecological economics revolves around sustainability and the long-term evolution of social-economic-ecological systems. Ecological economists have long called for the integration of economics with ecology and other natural sciences to better understand ecosystem services and the life-support system provided by the biosphere (Costanza 1991). Ecological economists have also called for a broader dialog between economists and other social scientists to better understand the many contributions of nature to human well-being. Ecological economists have produced many ecosystem service assessments, including relatively early work on the value of wetlands (e.g., Farber and Costanza 1987) and a widely cited but highly controversial effort that estimated the value of Earth's ecosystems at US $33 trillion per year (Costanza et al. 1997). Economist Mike Toman characterized the valuation of US $33 trillion for Earth's life-support system as "a serious underestimate of infinity" (Toman 1998).

Over the past few years there has been an explosion of interest in ecosystem services. The 2005 publication of the Millennium Ecosystem Assessment, which made ecosystem services its central focus, prompted a chain of efforts to address ecosystem services. Major recent studies include *Valuing Ecosystem Services: Towards Better Environmental Decision-making* (National Research Council 2005), *Valuing the Protection of Ecological Systems and Services* (U.S. Environmental Protection Agency Science Advisory Board 2009), *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature* (TEEB 2010), *Natural Capital: Theory and Practice of Mapping Ecosystem Services* (Kareiva et al. 2011), and the U.K. National Ecosystem Assessment (2011). All of these efforts blend economics with ecology and other disciplines to measure the provision and value of ecosystem services, and to think about policy levers to provide incentives for the sustainable provision of services.

Economics has many tools and analyses that can be applied to ecosystem services. Ecologist Joan Roughgarden provides a nice summary of how economists can add value in addressing issues such as the mainstreaming of ecosystem services:

> "It's tempting to suppose that the environment poses new problems that economists haven't begun to deal with. Yet this is less true than one might think. Economics in the first half of the 1900s considered limits to growth. Land area was taken as a constraint in early agricultural economics. Economists can deal conceptually with limits to growth perfectly well. Economists have long known how to fold into the price of an item all the costs of its production. A company that pollutes the environment can sell a product at an artificially low price because the public pays the cleanup. But the cost of the cleanup, called the social cost, should be fed back to the company with a special tax called a Pigovian tax. This topic is called "internalizing" an "externality" and has a long history of discussion. … Dealing with ecology does pose some new challenges for economics, but it is polite to know which these are. It is rude to assume that economists haven't considered the environment at all. In fact, they are often on our side, so let's keep them there." (Roughgarden 2001, 87)

MAINSTREAMING ECOSYSTEM SERVICES: "TIME TO DELIVER"

The building blocks for analyzing ecosystem services have been developed by prior work in economics and ecology. There is great interest on the part of many public and private entities in analysis of ecosystem services. Despite this, much of the work on ecosystem services to date has been largely conceptual. On-the-ground applications have been much rarer, though this is now beginning to change.

To some extent the largely conceptual stage was unavoidable in the early period of development. Ecosystem service analysis requires integration of ecology and economics (at a minimum), collection of new data, and a more holistic systems view to capture the joint provision of multiple services provided by ecosystems.

But now ecosystem service analysis has begun to mature, and has reached the stage where it can produce quantitative assessments of ecosystem service provision and value that are useful in policy and management contexts. It is high time to push forward on this front to make ecosystem service analysis practical and easy to implement, so that it becomes routine to include it (Daily et al. 2009). This section briefly explains a framework and set of tools useful for the analysis of ecosystem services. The next section provides example applications of the framework and tools to generate quantitative estimates of the provision and value of ecosystem services under policy and management alternatives.

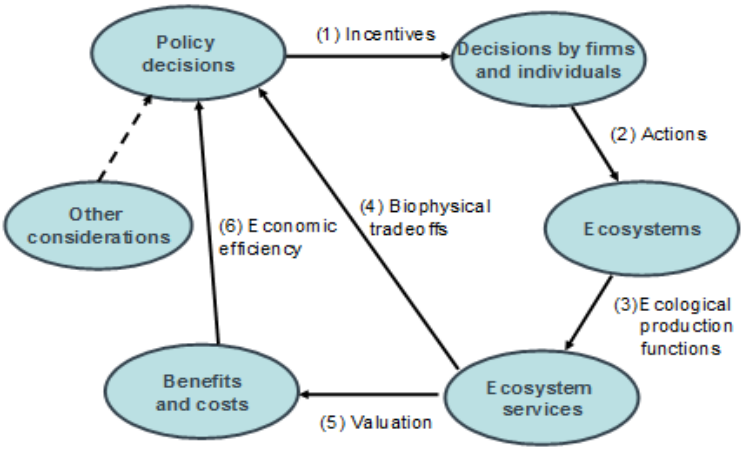


Figure 1: An integrated ecosystem services framework. *Source: Adapted from Polasky and Segerson (2009)*

As discussed in the introduction, there are three main tasks to address to successfully mainstream ecosystem services: 1) understand the *provision* of ecosystem services, 2) understand the *value* of services, and 3) provide *incentives* for their sustainable provision. Tackling these three tasks requires an integrated ecological–economic framework. Since most ecosystem services have elements of externalities or public goods, it is useful to begin by thinking about policies and incentives to internalize externalities or to create incentives for the provision of public goods (Link 1 in Figure 1). Policies provide the context for decision-making by individuals, businesses, and government agencies that make on-the-ground decisions that affect ecosystems (Link 2). Predicting behavioral responses to policy, such as the responses of businesses and individuals to shifts in taxes or subsidies, are well-studied in economics (Hanley et al. 1997).

Ecological and other natural science analyses often focus on understanding the environmental impacts of human actions. Translating human actions to impacts on ecosystems, and then from the condition of ecosystems — their structures, functions, and processes — into the provision of ecosystem services, is the key step in understanding the provision of ecosystem services (Link 3). This mapping from structure and function to services is called the ecological production function. It takes as input ecosystem conditions and predicts outputs of ecosystem services, much like a standard production function in economics maps from inputs to production of goods and services

(National Research Council 2005). The output of an ecological production function is measured in physical units, e.g., tons of carbon sequestered, or amount of phosphorus exported to surface water. It is possible to provide information about the tradeoffs in provision of services under alternative scenarios directly to managers and policy-makers (Link 4).

Alternatively, methods of economic valuation can be applied to provide estimates of the contribution of ecosystem services to human well-being in a common currency, typically in monetary terms (Link 5). Reporting in a common unit makes it easy for managers and policy-makers to understand the tradeoffs in the net benefits of services provided under alternative scenarios (Link 6). The advantage of using economic valuation is that it weighs all ecosystem services in terms of their contribution to human well-being using the consistent framework of welfare economics.

There are, however, several disadvantages to trying to measure all ecosystem services in monetary terms. Some ecosystem services, such as spiritual and cultural values, cannot be easily expressed in monetary values. In addition, there are practical measurement and data issues that can make the translation from biophysical measures to value difficult. A good example is the difficulty of establishing robust estimates of the value to society of clean water, or the value of the continued existence of a species. Whether it is better to report results in biophysical or monetary terms really comes down to which approach is easier to communicate. Sometimes it is easier to communicate with decision-makers and the general public in monetary terms, but in other instances it is clearer and more direct to keep things in biophysical terms.

The goal of The Natural Capital Project, a partnership between Stanford University, the University of Minnesota, The Nature Conservancy, and World Wildlife Fund, is to mainstream ecosystem services. As part of this objective, The Natural Capital Project has developed a software package called InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs). InVEST was developed to analyze the provision and value of multiple ecosystem services under alternative scenarios of land use and land management. Doing so allows users to see how alternative land use or land management choices will affect the provision and value of multiple ecosystem services. Doing so can generate useful information for decision-makers in evaluating which alternatives are better for achieving management or policy objectives.

InVEST is integrated in the sense that it predicts the joint provision of multiple ecosystem services generated by a landscape, and can evaluate tradeoffs or synergies in the provision of services. InVEST uses input on land use along with environmental information (e.g., soil, topography, climate) to generate spatially explicit predictions of the supply of ecosystem services. This information is combined with economic data on the demand for ecosystem services to generate estimates of the value of ecosystem services. InVEST can report outputs in either biophysical terms or economic terms. The modeling approach uses general functional relationships along with site-specific data, and is both flexible and widely applicable. The following section describes several applications of InVEST that illustrate the types of ecosystem service analyses that can be done.

EXAMPLE APPLICATIONS OF INTEGRATED ANALYSIS OF ECOSYSTEM SERVICES

Where to Put Things: Spatial Land Management with Biological and Economic Objectives

Land-use decisions often affect multiple and competing objectives. For example, clearing land for agriculture will increase food production but can result in declines in carbon sequestration and water quality. There will inevitably be some tradeoff among different societal objectives, but sometimes careful thought about the spatial pattern of land use or the methods used to accomplish certain activities can lead to overall improvement in system performance. In "Where to Put Things?" Polasky et al. (2008) analyzed land-use decisions in the Willamette Basin in Oregon to find land-use plans that achieved high levels of a conservation objective (conserving terrestrial vertebrate species) and an economic objective (generating income for landowners). The analysis showed that it was possible to do better on both biological and economic objectives compared to the current situation.

The starting point in the analysis was to specify the spatial pattern of land-use activity in the Willamette Basin to use as input for both a biological model and an economic model. The biological model evaluates a land-use plan's ability to support viable populations for a set of 267 terrestrial vertebrate species that inhabit the Willamette Basin at present. How well each species does for a given land-use pattern depends on three species-specific traits: 1) habitat compatibility that includes geographic range, habitat type, and special features like whether there is access to water; 2) the amount of habitat required for a breeding pair; and 3) dispersal ability between suitable patches of habitat. For each species, the biological model predicts the probability of persistence of the species as a function of the pattern of habitat under the land-use plan. The overall biological score is the expected number of species expected to persist on the landscape.

The economic model predicts the present value of monetary returns generated by a land use. For each land parcel, the economic returns depend upon the land use in the parcel and characteristics of the parcel. For parcels in forestry or agriculture, the model predicts timber yield or crop yield as a function of the parcel's soil quality, climate, and topography. Combining yield estimates with timber and crop prices and production cost data then generates an estimate of economic returns. For housing development, the model predicts property value for housing based on location relative to urban areas and the county in which the parcel is located. The overall economic score for the landscape is the sum of the present value of returns over all of the parcels.

The biological and economic models were used to score how well different land-use patterns fared in the dual objectives of conserving terrestrial vertebrate species and generating income for landowners. Using algorithms that intelligently searched over possible land-use patterns, the authors generated an efficiency frontier (Figure 2) showing the maximum biological score for a given economic score (or the maximum economic score, given a biological score). Starting from a landscape that maximizes the value of residential development and agricultural and timber production (point A in Figure 2), it is possible to increase species conservation with very little decrease in economic returns (shifting to point B or C in Figure 2).

Increases in species conservation can be accomplished by conserving relatively rare habitats such as prairie and oak savanna in places that do not have high economic value. Trying to conserve all species, however, may entail high costs (shifting to points F–H in Figure 2). The efficiency frontier shows that careful thinking about the arrangement of activities across the landscape makes it possible to sustain high levels of biodiversity and economic returns. Compared to the current land-use pattern, both species conservation and the value of economic activity can be increased substantially (Figure 2).

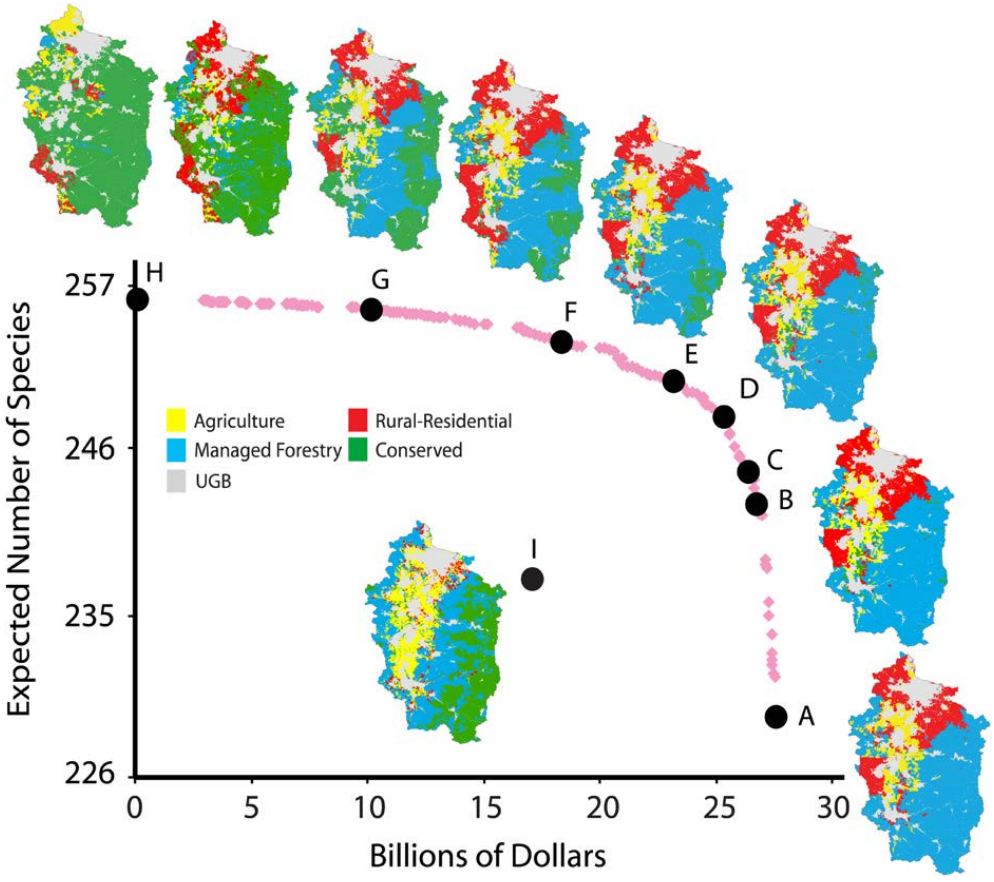


Figure 2: Land-use patterns associated with specific points along the efficiency frontier and the current landscape. *Each land-use pattern shown outside of the efficiency frontier corresponds to a lettered point on the frontier. The current land-use pattern is also shown (point I). Compared to the current landscape, points on the efficiency frontier have less agriculture and more rural-residential use. There is a shift from predominantly managed forest toward conservation land as the biological objective is emphasized relative to the economic objective. Source: Polasky et al. (2008)*

Modeling Multiple Ecosystem Services and Tradeoffs at Landscape Scales

"Where to Put Things" illustrates the basic approach of evaluating alternative land-use plans in terms of more than one objective, illustrating tradeoffs between objectives along the efficiency frontier and the potential for win-win outcomes relative to the current

situation. "Modeling Multiple Ecosystem Services, Biodiversity Conservation, Commodity Production, and Tradeoffs at Landscape Scales" uses the same basic data for the Willamette Basin but expands the set of objectives to include a bundle of ecosystem services (Nelson et al. 2009).

In this analysis, the InVEST model was used to track water quality (phosphorus loadings), flood control, soil conservation (sediment retention), climate stabilization (carbon sequestration), species conservation, and market returns to landowners (agricultural crop production, timber harvest, and housing values). These outcomes are a function of land characteristics and land-use and land-cover patterns using data at 30x30 m resolution. The water quality, flood control, and soil conservation models all use models that track water flows, accounting for input from precipitation minus evapotranspiration and routing via a digital elevation map. Phosphorus loadings are a function of inputs from fertilizers as well as retention, while sediment loading is calculated using the Universal Soil Loss Equation (Wischmeier and Smith 1978). The model tracks the amount of carbon stored in above- and below-ground biomass, soil, and harvested wood products. Species conservation is modeled using species-area curve relationships. Economic returns use the methods from Polasky et al. (2008) discussed above.

Rather than consider all possible land-use plans to find the efficiency frontier, this analysis used the results from the Pacific Northwest Ecosystem Research Consortium, a multi-stakeholder alliance of government agencies, non-governmental organizations, and universities convened to imagine different future scenarios for the Willamette Basin (Hulse et al. 2002). The Consortium generated three scenarios of land-use and land-cover change: 1) plan trend — a "business-as-usual" trajectory that continues past trends, 2) development — a trajectory with increased population growth and more extensive housing development, and 3) conservation — a trajectory that emphasizes preserving and restoring natural habitat. For each scenario, the Consortium produced a map of land use and land cover for the entire Willamette Basin for each decade from 1990 to 2050 (Figure 3). Each of these maps was used as input for InVEST. The outcome of the analysis was a score for each objective for each scenario for each decade (Figure 4).

The conservation scenario scored higher than either of the other two scenarios for all objectives except the market value of returns to landowners. Since landowners do not currently receive payments for providing ecosystem services, it is likely that they would choose outcomes that more closely follow the plan trend or development scenario than the conservation scenario. If, however, landowners received payments for ecosystem services so that they internalized at least some of the value of the services the land provides, the situation would be quite different. Including payments for just one ecosystem service, carbon sequestration, was enough to make the monetary returns for the conservation scenario exceed the monetary returns for either the plan trend or development scenario. This type of analysis points to the potential for policies that internalize the currently external values of ecosystem services to create vastly different decisions, with consequent changes in provision and value of ecosystem services, biodiversity conservation, and returns to landowners.

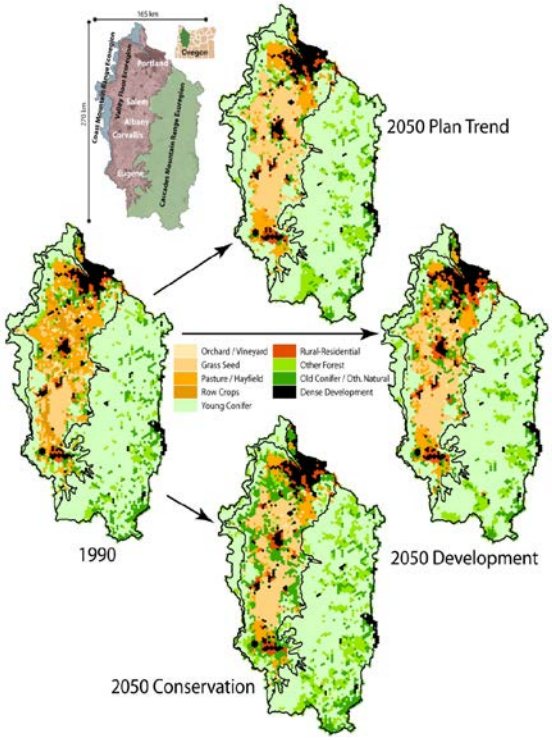


Figure 3: Maps of the Willamette Basin with the land use/land cover patterns for 1990 and three scenarios for 2050. *Source: Nelson et al. (2009)*

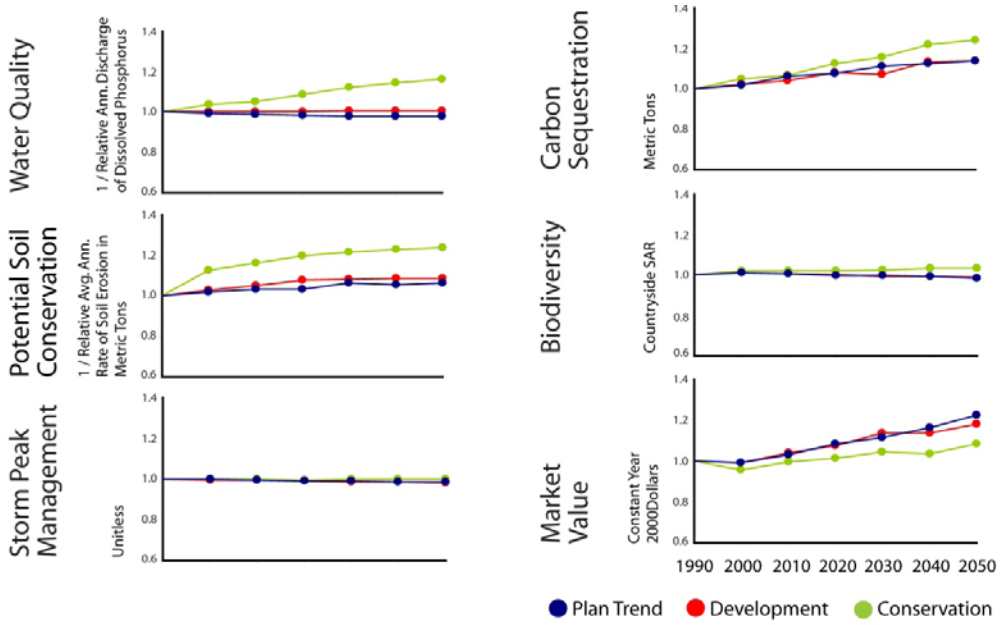


Figure 4: Comparison of landscape ecosystem services scores, biodiversity conservation status, and market values of commodity production for the three land-use change scenarios from 1990 to 2050. *Source: Nelson et al. (2009)*

Ecosystem Service Analysis Kamehameha Schools, O'ahu, Hawai'i

The Natural Capital Project worked closely with Kamehameha Schools, an educational trust and the largest private landowner in the State of Hawai'i, to evaluate the consequences of alternative land-use scenarios for a large block of land it owned on the north shore of the island of O'ahu (Figure 5). Representatives of Kamehameha Schools, working with researchers from the Natural Capital Project, developed three spatially explicit land-use scenarios: 1) sugarcane ethanol — returning former plantation lands to sugarcane cultivation to produce ethanol biofuel, 2) diversified agriculture and forestry — using irrigated fields near the coast for diversified agriculture and planting native trees on higher-elevation fields, and 3) residential subdivision — selling coastal and former plantation lands for a residential housing development. Representatives of Kamehameha Schools also determined the endpoints they were interested in evaluating: water quality (nitrogen discharge), carbon storage, and income generation. InVEST was then used to evaluate the impacts of each land-use scenario on each ecosystem service of interest.

All three scenarios generated higher income than the base case land use, which actually lost money, but only the diversified agriculture and forestry scenario also increased carbon storage (Figure 6). Representatives of Kamehameha Schools used the results of the InVEST analysis along with other considerations, such as how each scenario would affect the number of jobs, the rural character of the north shore, the sense of place, the maintenance of sacred burial grounds, and other historical factors, to help them determine which land-use plan was most desirable.

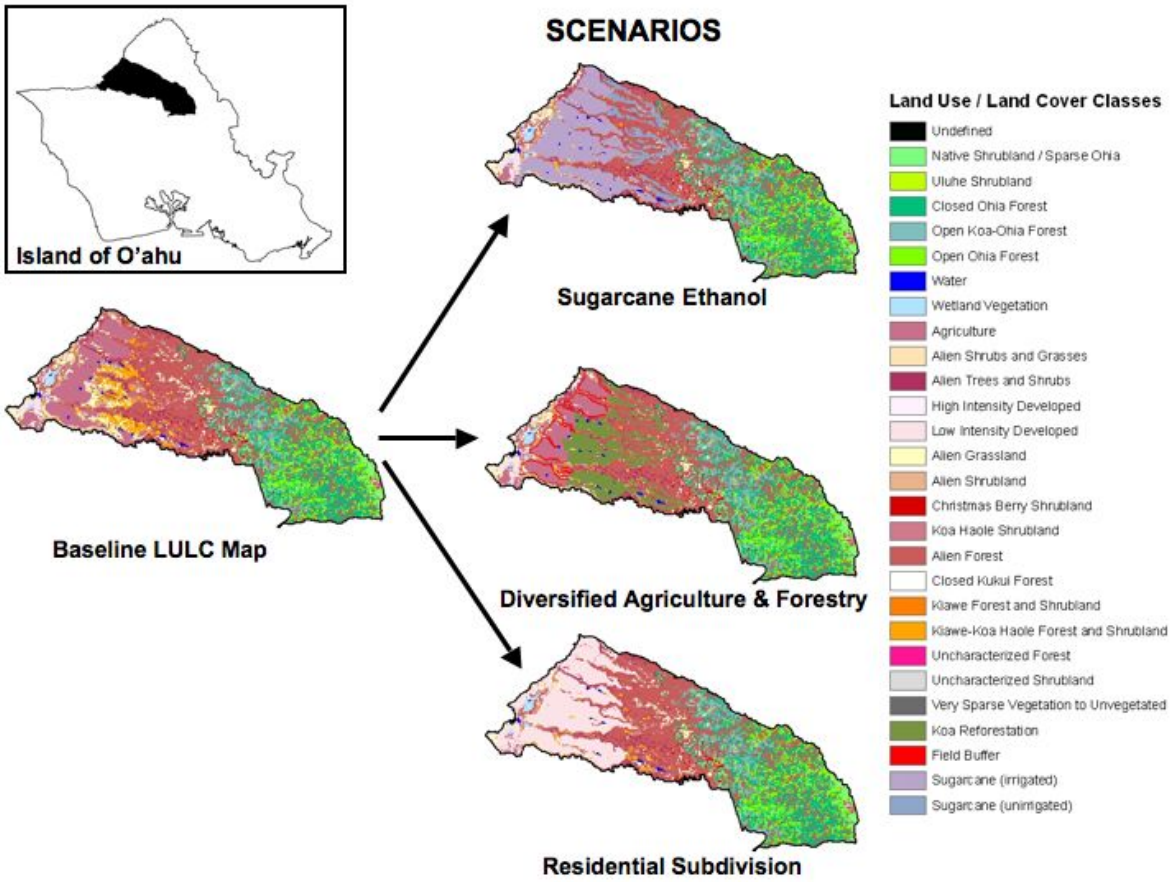


Figure 5: Land-use/land-cover maps for the InVEST analysis on O'ahu's north shore. *The area shown here includes all of Kamehameha Schools' landholdings, as well as small adjacent parcels that make a continuous region. The baseline map is from the Hawai'i Gap Analysis Program's land-cover layer for O'ahu (2006). Source: Polasky et al. (2011a)*

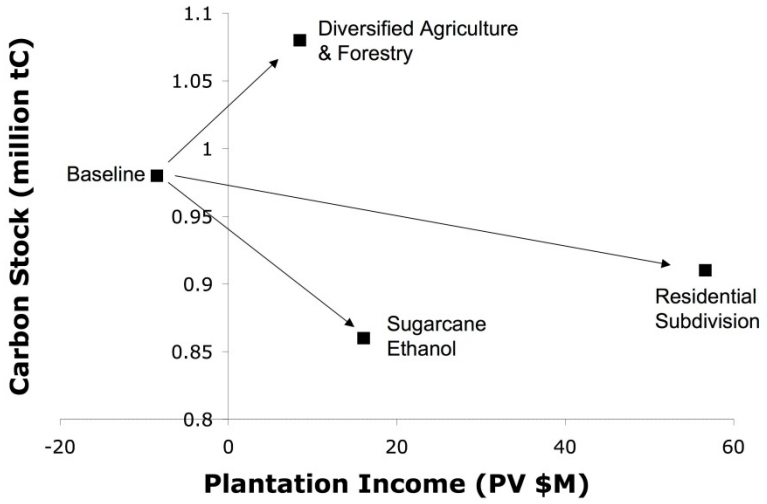


Figure 6: Projections of carbon stock and income from the plantation lands for the north shore region of O'ahu for the baseline land-use/land-cover map and the three planning scenarios (sugarcane ethanol, diversified agriculture and forestry, residential subdivision). *Source: Polasky et al. (2011a)*

Efficiency of Incentives to Jointly Increase Carbon Sequestration and Species Conservation on a Landscape

The prior three applications all started their analysis with land-use plans, either generated by stakeholders or, in the case of "Where to Put Things," as part of the analysis to generate an efficiency frontier. In most landscapes (Kamehameha Schools being an exception), there are multiple landowners, each of whom makes a decision on how to use his or her parcel of land. Laws and regulations, such as zoning or environmental laws, can prohibit certain uses or influence decisions, but individual landowners retain great discretion in determining land use. In cases where multiple landowners have decision-making power, it is important to analyze the link between policy framework and landowner decision-making that determines actual land use. Nelson et al. (2008) provide an example of how to analyze the impact of incentives that pay landowners to enroll in a conservation program.

The first step in this analysis was to build a statistical model of land-use change using data on past land-use choices and parcel-level characteristics that predict the economic returns landowners would receive had they chosen different land uses. This model estimates how much more likely a landowner is to choose a particular land use as the returns for that land use increase. The statistical model is then used to simulate each landowner's willingness to accept a payment to enroll in the conservation program. If the conservation payment offered to a landowner exceeds the willingness-to-accept, the landowner enrolls in the conservation program; otherwise, he or she does not. The statistical model and conservation policy simulation determined the land-use map for a given conservation policy. The resulting land-use map was then evaluated in terms of species conservation, carbon sequestration, and economic returns, similar to the evaluations in the studies discussed above.

The outcomes under various policies were compared with each other and with the efficient outcomes (Figure 7), using methods similar to those in "Where to Put Things." The policy scenarios considered varied eligibility criterion for who could enroll, as well as the total budget available for conservation. The various policy scenarios included were:

- all landowners — everyone was eligible to enroll
- native habitat — eligibility was restricted to land in certain rare habitat types
- carbon storage — eligibility was restricted to land that could be converted to forest
- riparian — eligibility was restricted to land along riparian corridors
- species of concern — eligibility was restricted to land shown by prior analyses to be important habitat for species of concern

All of the policy scenarios for each annual budget level (US $1, $5, and $10 million) produced changes in species conservation and carbon scores relative to the baseline of no conservation program that were well inside the efficiency frontier showing the maximum potential gain. The inefficiency of the conservation programs occurred because the policy induced the wrong set of landowners to enroll in the program, resulting in a land-use pattern that generated inferior results in terms of species conservation and carbon storage. The analysis also showed that it was possible to target policies to obtain certain ecosystem services (e.g., carbon storage), but that such targeting did not necessarily also obtain good outcomes for other objectives (e.g., species conservation).

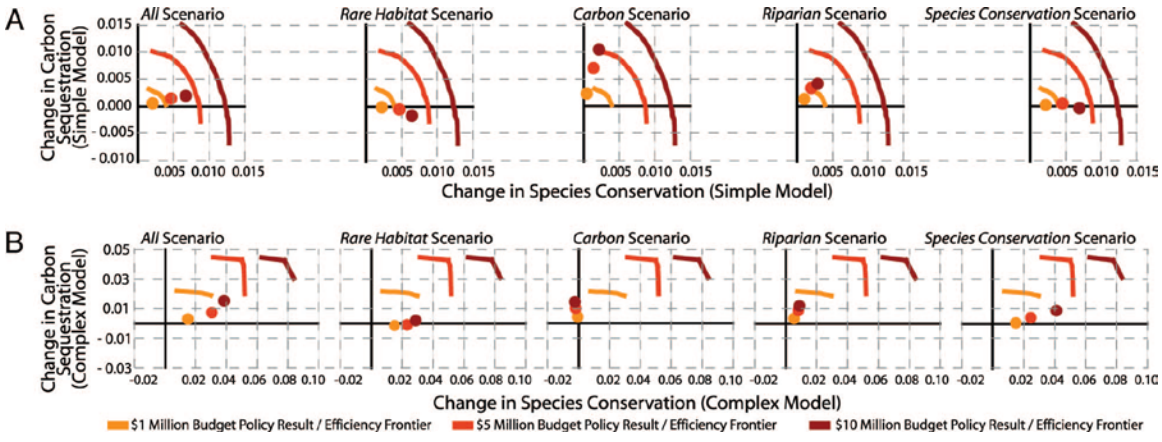


Figure 7: Comparison of increase in species conservation and carbon sequestration relative to the base case with budgets of US $1, $5, and $10 million dollars for different policy scenarios. *Each circle represents an outcome under a policy scenario for a given size budget. The lines indicate estimates of the efficiency frontier. (A) Uses simple species conservation and carbon sequestration models; (B) uses more advanced models. Source: Nelson et al. (2008)*

THE PATH FORWARD

The ability to analyze the provision and value of a bundle of ecosystem services at a local or regional scale is advancing rapidly. Spatially explicit data and models have been developed to help decision-makers assess the impact of various policy alternatives on ecosystems and ecosystem services, and thus link their decisions to consequences for human well-being. Tools such as InVEST can help to show the impacts of alternative decisions on the joint provision of multiple ecosystem services (ecological production functions), show the value of ecosystem services in terms of their contribution to human well-being, and analyze the impacts of policy mechanisms intended to internalize externalities and provide public goods.

There is an emerging information base on which to proceed with "mainstreaming ecosystem services," so that the value of such services is factored into the everyday decisions of individuals, businesses, and government agencies. While there are still improvements to be made, existing data, models, and understanding can yield significant improvements in societal decision-making and management compared to current performance. For example, the Willamette Basin studies have shown that analyses that include explicit spatial analysis and incorporate both ecological and social-economic factors can improve outcomes in terms of economic and conservation objectives. Studies based in other regions, including Hawai'i (discussed above), Minnesota (Polasky et al. 2011b), and elsewhere, have come to similar conclusions. Application of InVEST or similar models is ongoing in Colombia, China, South Africa, Tanzania, and elsewhere. Perhaps the silver lining of starting from poor baseline performance is that it is easy to improve.

At this point there are no major impediments standing in the way of mainstreaming ecosystem services. There are, however, numerous scientific, economic, and institutional details that are important to get right and will require careful attention from scientists, economists, and practitioners. There is great interest in mainstreaming ecosystem services, and major efforts are underway in a number of countries to tackle these issues (e.g., TEEB 2010, Kareiva et al. 2011, The U.K. National Ecosystem Assessment 2011). Bridging this interest and desire to reality will require careful attention to questions such as whether contracts are being adequately monitored and enforced, and whether payments for ecosystem services are really generating additional provisions of services and ensuring the maintenance of natural capital that is required for continued future supply of services.

Mainstreaming ecosystem services should be viewed as a long-term process rather than a quick-fix solution. We will learn from experience, and should use what we learn to improve our collective ability to sustain the provision and value of ecosystem services. Putting what we know into practice will require further advances and refinements of the science, but perhaps more importantly, it will require a concerted effort to reform policies and institutions. Perhaps most important of all is a shift in the collective mindset, from taking nature for granted to recognizing the importance of investing in natural capital and ecosystem services. Doing so might result in a true "green revolution," with increases in ecosystem services similar to 20th century accomplishments in the provision and value of marketed commodities.

REFERENCES

Arrow, K., B. Bolin, R. Constanza, P. Dasgupta, C. Folke, C.S. Holling, B.-O. Jansson, S. Levin, K.-G. Maler, C. Perrings, and D. Pimentel. 1995. Economic growth, carrying capacity, and the environment. *Science* 268:520–521.

Arrow, K., P. Dasgupta, L. Goulder, G. Daily, P. Ehrlich, G. Heal, S. Levin, K.-G. Mäler, S. Schneider, D. Starrett, B. Walker. 2004. Are we consuming too much? *Journal of Economic Perspectives* 18(3):147–172.

Costanza, R., ed. 1991. *Ecological economics: The science and management of sustainability*. New York: Columbia University Press.

Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Pareulo, R. G. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253–260.

Czech, B. 2000. *Shoveling fuel for a runaway train: Errant economists, shameful spenders, and a plan to stop them all*. Berkeley, CA: University of California Press.

Daily, G. C., ed. 1997. *Nature's services: Societal dependence on natural ecosystems*. Washington, DC: Island Press.

Daily, G., S. Polasky, J. Goldstein, P. M. Kareiva, H. A. Mooney, L. Pejchar, T. H. Ricketts, J. Salzman, and R. Shallenberger. 2009. Ecosystem services in decision-making: Time to deliver. *Frontiers in Ecology and the Environment* 7(1):21–28.

Dasgupta, P. 2001. *Human well-being and the natural environment*. Oxford, UK: Oxford University Press.

DeLong, J. B. 2003. Estimating world GDP, one million B.C. — present. Berkeley, CA: Department of Economics, University of California, Berkeley. http://econ161.berkeley.edu/TCEH/1998_Draft/World_GDP/Estimating_World_GDP.html.

Ehrenfeld, D. 1988. Why put a value on biodiversity? In *Biodiversity*, E. O. Wilson, ed. Washington, DC: National Academy Press.

Ehrlich, P. R., and H. A. Mooney. 1983. Extinction, substitution, ecosystem services. *BioScience* 33(4):248–254.

Farber, S., and R. Costanza. 1987. The economic value of wetland systems. *Journal of Environmental Management* 24:41–51.

Hanley, N., J. Shogren, and B. White. 1997. *Environmental economics in theory and practice*. New York: Macmillan.

Hall, C. A. S., P. W. Jones, T. M. Donovan, and J. P. Gibbs. 2000. The implications of mainstream economics for wildlife conservation. *Wildlife Society Bulletin* 28(1):16–25.

Hawai`i Gap Analysis Program [CD-ROM]. 2006. *Land cover*. Honolulu, HI: United States Geological Survey.

Hotelling, H. 1931. The economics of exhaustible resources. *Journal of Political Economy* 39:137–175.

Hulse, D., S. Gregory, and J. Baker, eds. 2002. *Willamette River basin planning atlas: Trajectories of environmental and ecological change*. Corvallis, OR: Oregon State University Press.

Johnson, D. G. 2000. Population, food and knowledge. *American Economic Review* 90(1):1–14.

Kareiva, P., H. Tallis, T. H. Ricketts, G. C. Daily, and S. Polasky, eds. 2011. *Natural capital: Theory and practice of mapping ecosystem services*. Oxford, UK: Oxford University Press.

Kinzig, A., C. Perrings, F. S. Chapin III, S. Polasky, V. K. Smith, D. Tilman, and B. L. Turner II. 2011. Paying for ecosystem services — promise and peril. *Science* 334:603–604.

Krutilla, J. 1967. Conservation reconsidered. *American Economic Review* 57:777–786.

Krutilla, J. V., and A. C. Fisher. 1975. *The economics of natural environments: Studies in the valuation of commodity and amenity resources*. Baltimore, MD: Johns Hopkins University Press.

McCauley, D. 2006. Selling out on nature. *Nature* 443:27–28.

Millennium Ecosystem Assessment. 2005. *Ecosystems and human well-being: Synthesis*. Washington, DC: Island Press.

National Research Council. 2005. *Valuing ecosystem services: Toward better environmental decision-making*. Washington, DC: National Academies Press.

Nelson, E., G. Mendoza, J. Regetz, S. Polasky, H. Tallis, D. R. Cameron, K. M. A. Chan, G. Daily, J. Goldstein, P. Kareiva, E. Lonsdorf, R. Naidoo, T. H. Ricketts, and M. R. Shaw. 2009. Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales. *Frontiers in Ecology and the Environment* 7(1):4–11.

Nelson, E., S. Polasky, D. J. Lewis, A. J. Plantinga, E. Lonsdorf, D. White, D. Bael, and J. J. Lawler. 2008. Efficiency of incentives to jointly increase carbon sequestration and species conservation on a landscape. *Proceedings of the National Academy of Sciences of the United States of America* 105(28):9471–9476.

Pigou, A. C. 1920. *The economics of welfare*. London: Macmillan.

Polasky, S., G. Caldarone, T. K. Duarte, J. Goldstein, H. Hannahs, T. Ricketts, and H. Tallis. 2011a. Putting ecosystem service models to work: Conservation, management and tradeoffs. In Kareiva, P. M., et al., eds. *Natural capital: Theory and practice of mapping ecosystem services*. Oxford, UK: Oxford University Press.

Polasky, S., E. Nelson, D. Pennington, and K. Johnson. 2011b. The impact of land-use change on ecosystem services, biodiversity and returns to landowners: A case study in the state of Minnesota. *Environmental and Resource Economics* 48(2):219–242.

Polasky, S., E. Nelson, J. Camm, B. Csuti, P. Fackler, E. Lonsdorf, C. Montgomery, D. White, J. Arthur, B. Garber-Yonts, R. Haight, J. Kagan, A. Starfield, and C. Tobalske. 2008. Where to put things? Spatial land management to sustain biodiversity and economic returns. *Biological Conservation* 141(6):1505–1524.

Polasky, S., and K. Segerson. 2009. Integrating ecology and economics in the study of ecosystem services: Some lessons learned. *Annual Review of Resource Economics Annual Review of Resource Economics* 1:409–434.

Roughgarden, J. 2001. Guide to diplomatic relations with economists. *Bulletin of the Ecological Society of America* 82(1):85–88

TEEB. 2010. *The economics of ecosystems and biodiversity: Mainstreaming the economics of nature: A synthesis of the approach, conclusions and recommendations of TEEB*. Geneva: The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org.

Tietenberg, T., and L. Lewis. 2009. *Environmental and natural resource economics*, 8th ed. New York: Prentice Hall.

Toman, M. 1998. Why not calculate the value of the world's ecosystem services and natural capital? *Ecological Economics* 25:57–60.

U.K. National Ecosystem Assessment. 2011. *The UK national ecosystem assessment technical report*. Cambridge, UK: UNEP-WCMC.

U.S. Environmental Protection Agency, Science Advisory Board. 2009. *Valuing the protection of ecological systems and services*. EPA-SAB-09-012. Washington, DC: U.S. EPA.

Wischmeier, W. H., and D. D. Smith. 1978. Predicting rainfall erosion losses — a guide to conservation planning. USDA Agricultural Handbook No. 537. Washington, DC: U.S. Department of Agriculture.

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Seminar

2

Theory of Ecosystem Services

Speaker

Dr. Stephen Polasky

2011 ECOSYSTEM SERVICES SEMINAR SERIES

GORDON AND BETTY MOORE FOUNDATION

Ecosystem Services Seminar 2: Theory of Ecosystem Services

Presentation and Discussion Notes From Speaker: Dr. Stephen Polasky

Seminar Series and Seminar 2 Goals:

The goal of the multi-session seminar is to educate the broader conservation community including practitioners and funders on the diverse aspects of ecosystem services – such as how to account for ecosystem services and to effectively measure, manage, and communicate them.

Seminar 2 focused on the following goals:

- *Describe basic economic theory behind ecosystem services*
- *Introduce different models of ecosystem services and basic economic analysis*
- *Discuss non-voluntary and voluntary markets*

Disclaimer:

This document is a summary that includes PowerPoint slides from the speaker, Dr. Stephen Polasky, and notes of his talking points. In addition, we provide a synthesis of important questions discussed during Seminar 2. Please keep in the mind that the following document is only a recap of Dr. Polasky's presentation and Blue Earth Consultants' notetakers have, to the best of their ability, captured the speaker's presentation. We hope that the following presentation and discussion notes will be used as resource to advance further discussions about ecosystem services.

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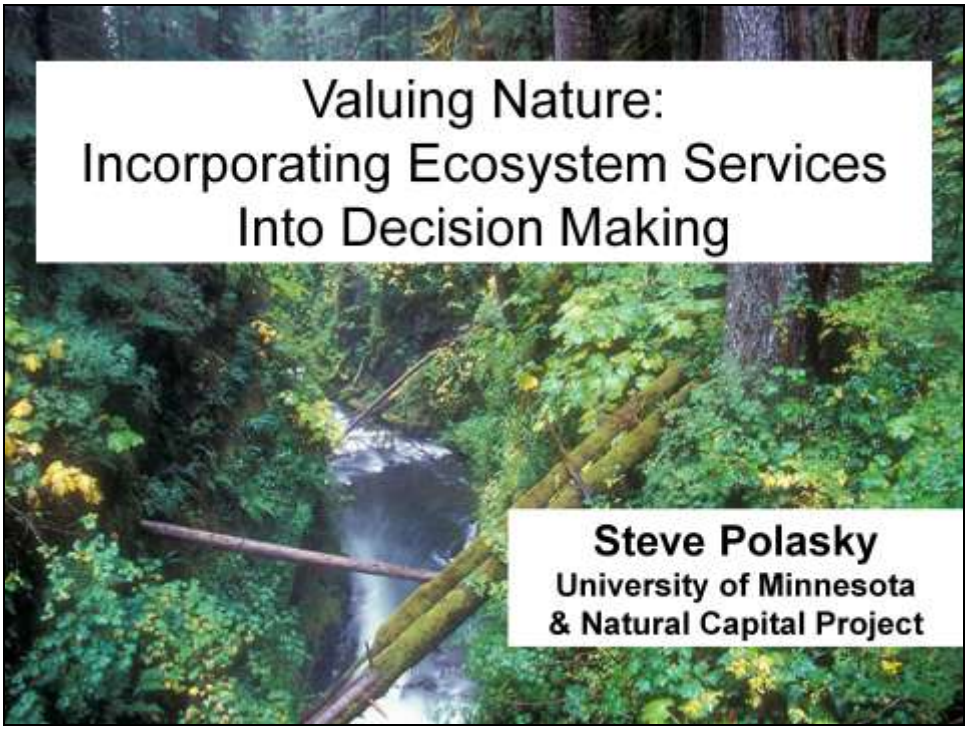


Presentation Goal:

- To explore Ecosystem Services (ES) in the context of planning and decision-making. We recognize this is but a tool and that there are others.

- Humans are affecting the globe in profound ways.
- That effect is often invisible to the decision-maker.
  - How do we then get over the distortions and make ES visible?

Main Theme:

- How do we bring ES into everyday decisions of business, individuals, and government agencies?

Sub Theme:

- The concept of ES is mainstream or should be; ES is standard economics applied to an interesting set of questions.

- Economics systems are information systems. One thing the economic systems do well is provide signals of value, i.e., what do producers produce *well* and what do consumers *want*?
- The problem with ES is that we do not have clear signals of value for ecosystem services and there is no clear feedback loop. ES values are not fed back to agencies, etc…. THIS IS THE MAIN PROBLEM
    - We tend to think of ES as externalities and public goods. There is no direct feedback link.
    - So we undervalue these services.
- ES are rife with these market failures.

Clouded vision

- We lack the right set of measures and accounts to judge the full consequences of our actions
- Distorted views leads to distorted decisions

5

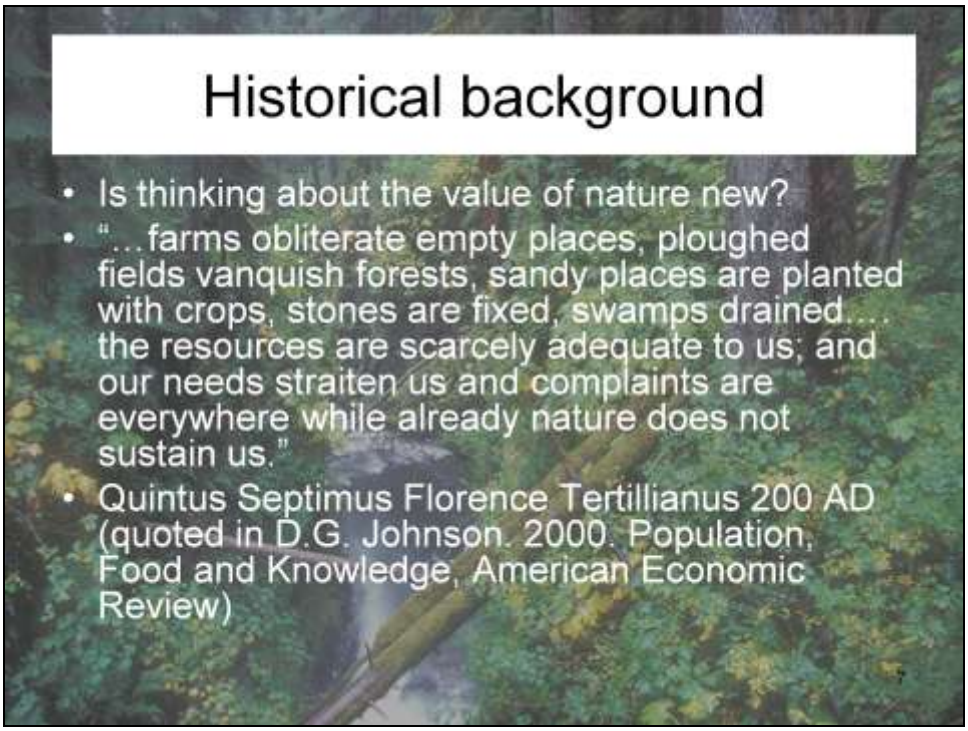
• Without the proper feedback, we have clouded visions. It's like you are driving a car with a malfunctioning speedometer, faulty brakes, or cloudy window…

• This clouded vision makes it hard to perceive the consequences of our actions.

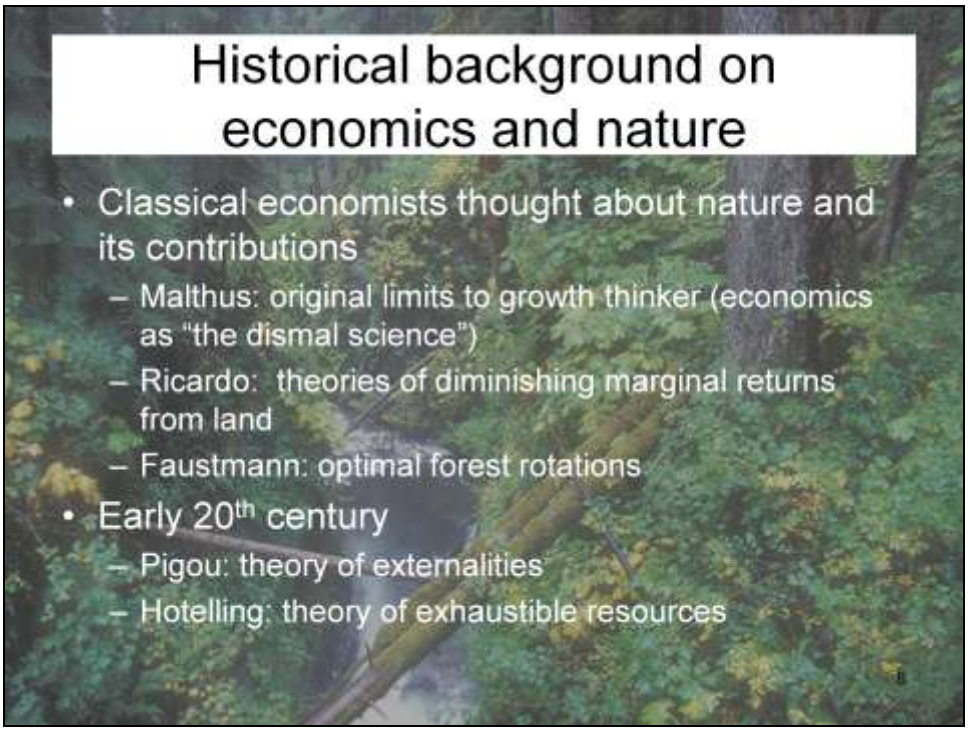
• Maybe not the best analogy because in reality, we can see really clearly out of half of the window. We see the market part well, but not the ES value part well.

- How then do we fix this distorted view a get a picture of the whole?

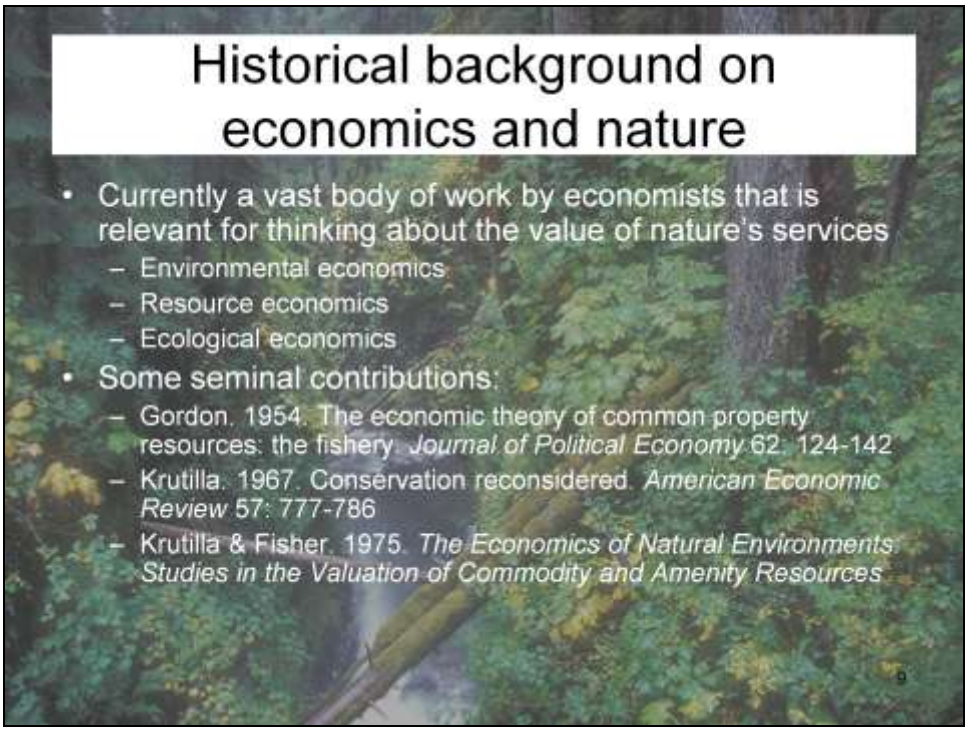
- How do we get accounting to provide the full spectrum?



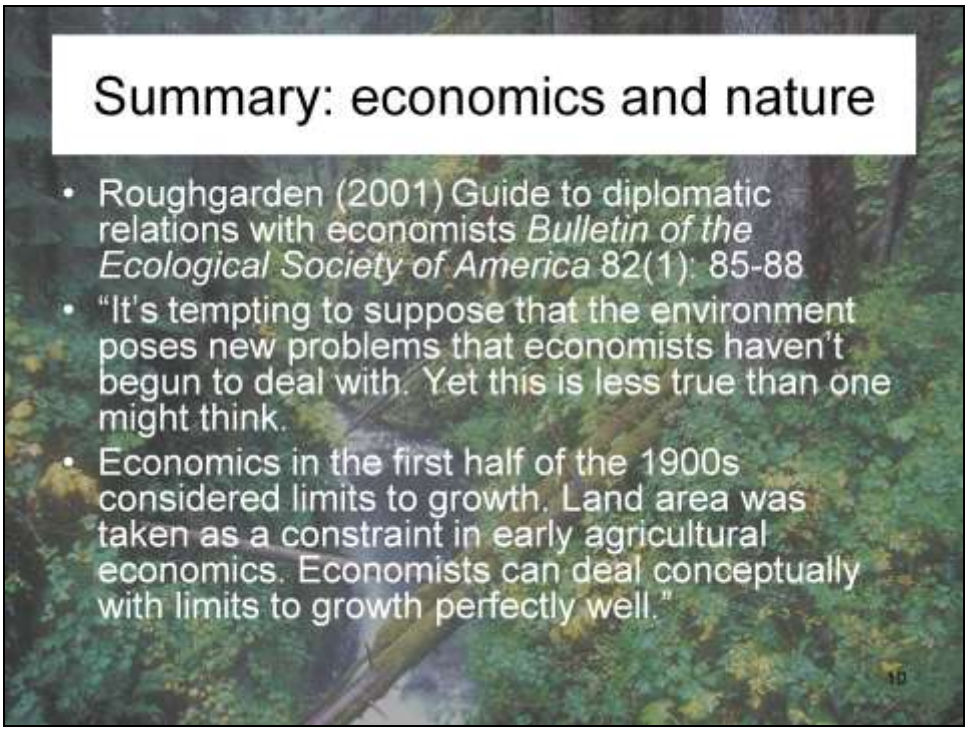
- Thinking about nature is not new! We have been doing it for a long time.



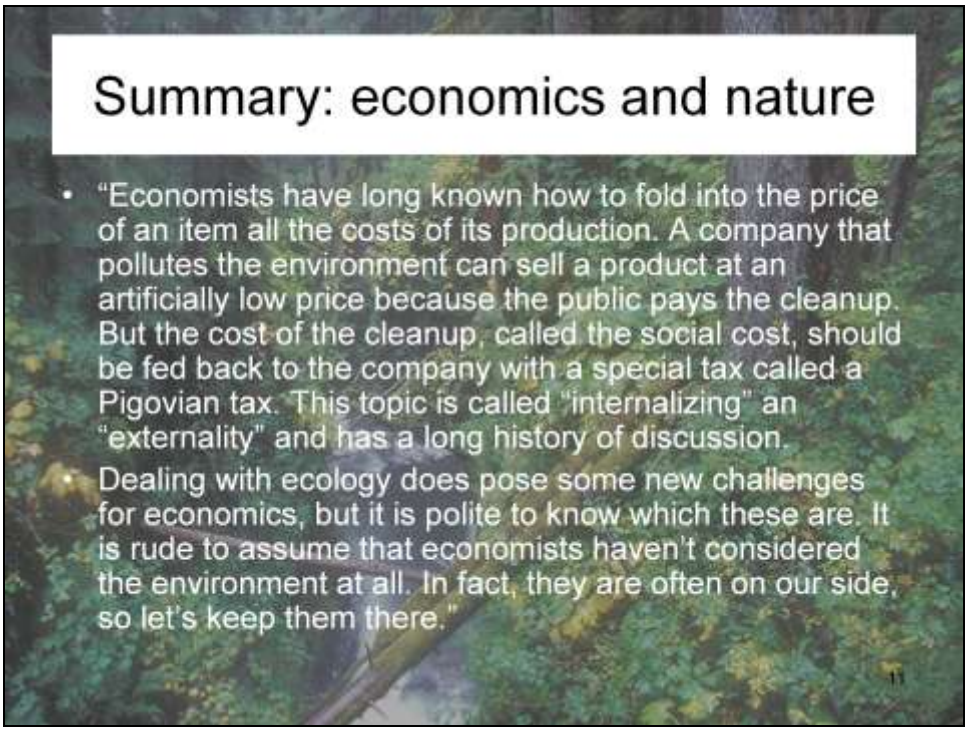
- In economics, the idea goes way back as well. Questions about the value of resources and the environment were very prominent.
    - Thomas Malthus: the dismal science
    - Ricardo: looked at fundamental economic concepts from agricultural background, diminishing marginal returns. The theory of rent stemmed from this as well.
    - Many early thoughts about optimal rotation age for crops.
        - ➢ What is the value of resources, the value of the environment etc?



- Now, there are many schools of thought or many names for resources economics, *see slide*.
- Seminal contributions:
    - Only a few are listed to communicate that this is not a new idea from 2000.



- Roughgarden (Stanford) wrote a great piece about ES and how to think about it etc… Proceedings were put out in Wildlife Society Proceedings. The idea used to be that economics was the worst thing for environments. Joan Roughgarden challenged that idea, *see slide 10 and 11.*
- Economics is fundamentally about allocating scarce resources, and internalizing the externalities.

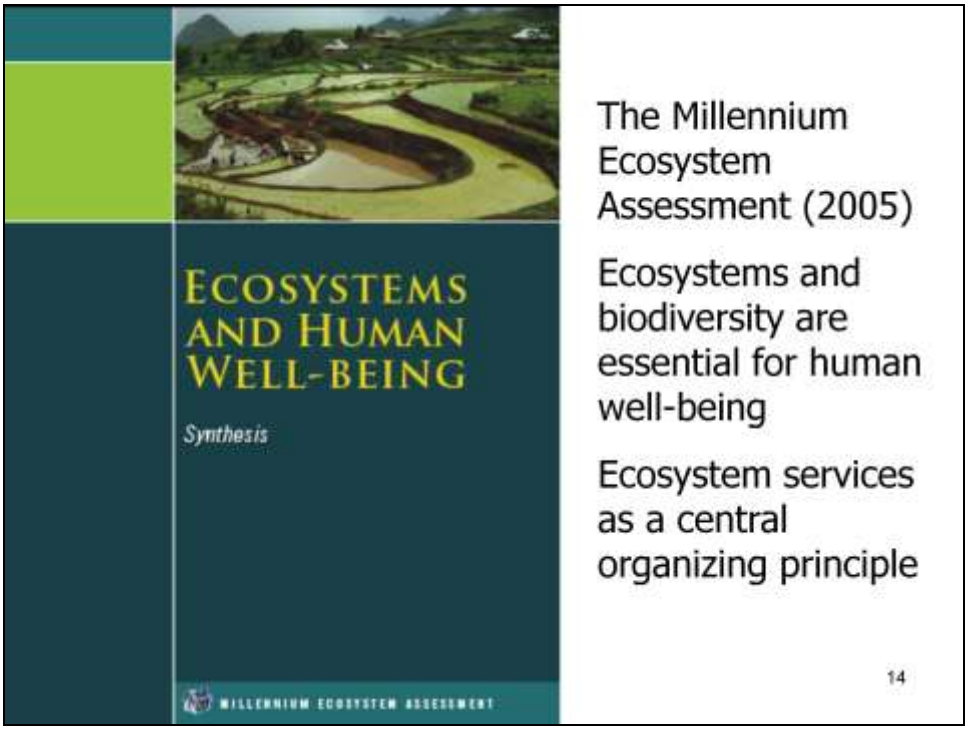


- Continued quotes from Joan Roughgarden.

What is new to ES?

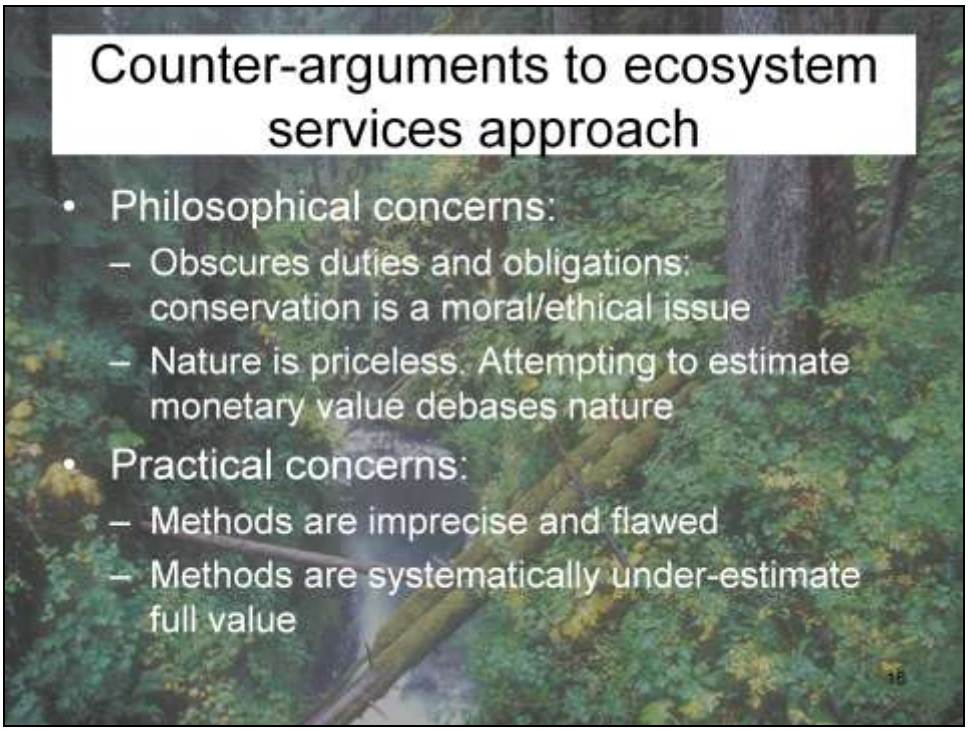
- The modern focus of ES can be traced to the 1980-90s to people like Hal Mooney, Paul Ehrlich, Gretchen Daily, and Robert Costanza.
- The late 1990s marked a time when a lot of work of ES began, in the modern sense. It is mostly defined by promoting the concept and less about the process.
- Now, ES is much more about understanding ecosystem processes and much more about an integrated systems view.

- There is a much closer linkage with ecologists now than before.
- Much more of an integrated system view now than in the 1970s.
- Not just the value of fish or oil, now thinking about the joint provision of multiple ecosystem services coupled with land use changes…



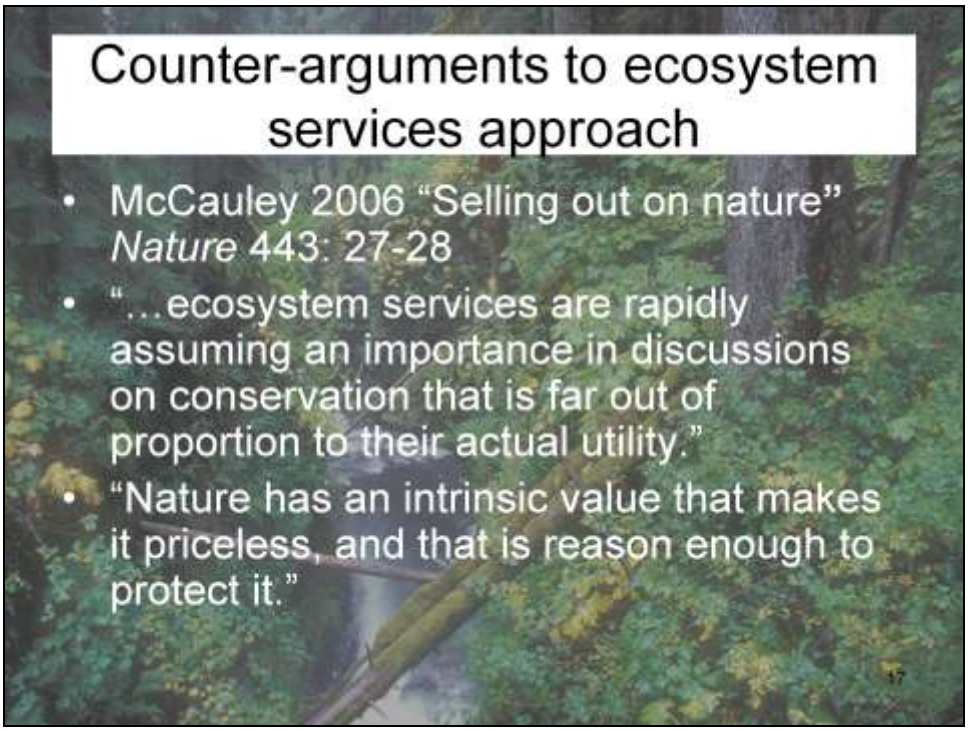
- Impetus for where we are now mostly comes from 2005 and the Millenium Ecosystem Assessment (MEA), *see above*. This made ecosystems central figures.
- Gave the necessary push to integrate ecology and economics.

- The field has begun to flower. List above shows the many government agencies and new studies. There is always a new commission and new reports etc…
- The theory of ES seems poised to take off.
  - What do we have to do to get beyond academic studies? *We will return to this later in the presentation.*

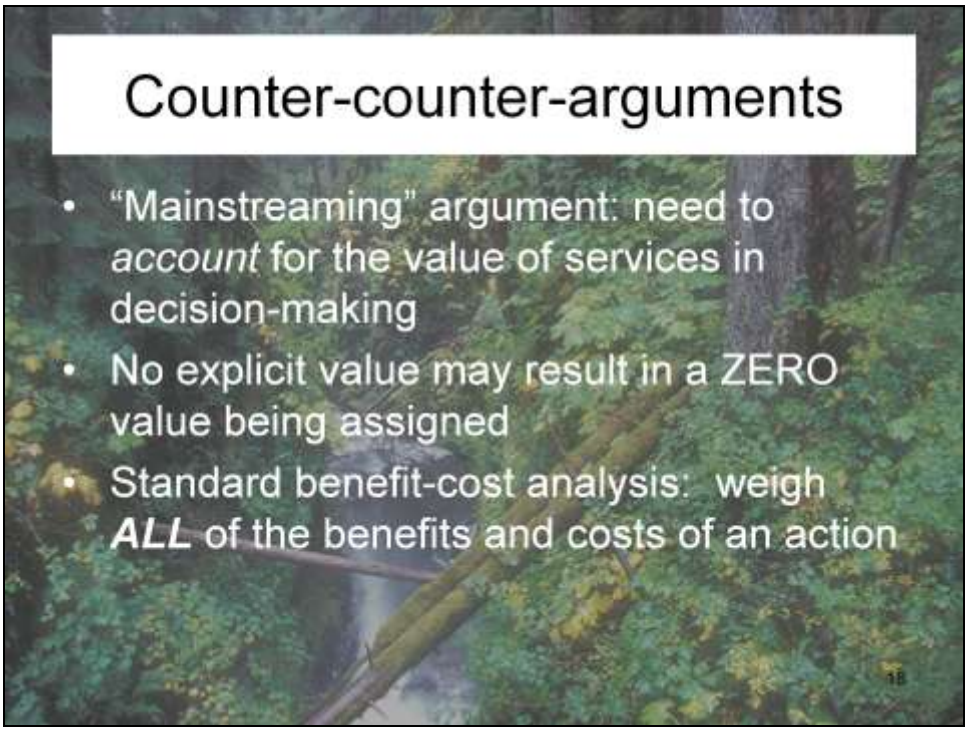


Some important things to note:

- Not everyone thinks this is the best way to approach these issues for 2 main reasons
    - Philosophical
        - Issues with viewing nature as an instrument for human well-being. Need to think about it on its own and not just what it does. Economists think about value and price and others think about rights and duty.
    - Practical Concerns
        - Can we do this? Can we do this <u>well</u> to actually inform and make better decisions? Or will it be very imprecise? It is hard to quantify it all…we will undervalue the services.



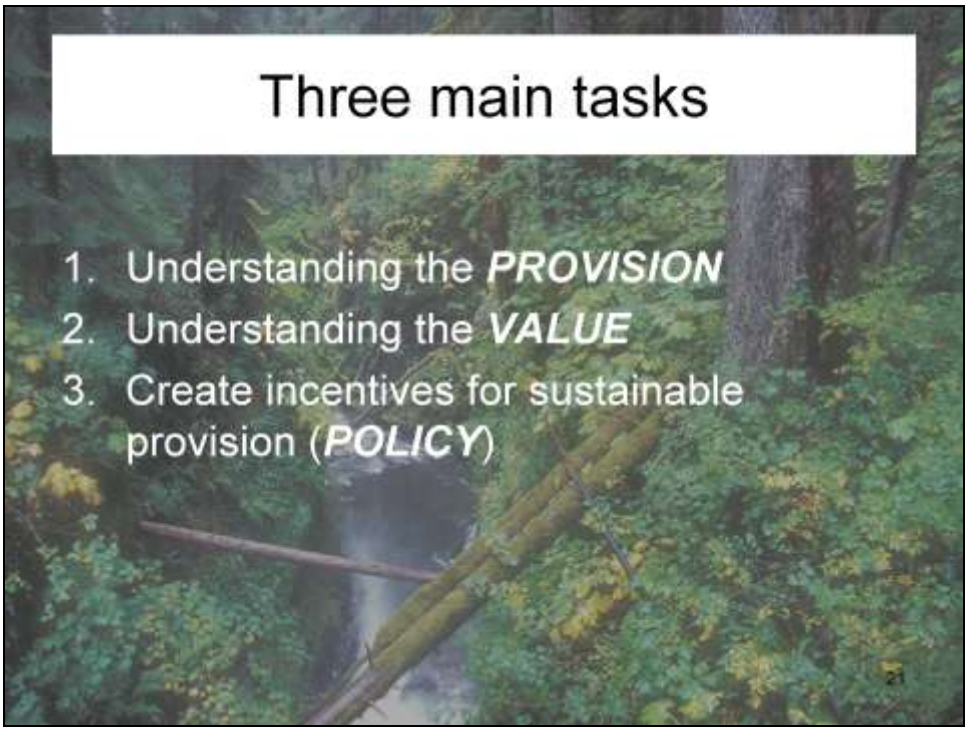
- McCauley quote, *see slide*, demonstrates the view that we will undervalue nature; it represents the notion that nature is priceless and we must protect it for that reason.



- We can argue philosophy, but that puts yourself on the sidelines. Real people are trying to do this and make it a good tool. Instead of arguing philosophy, get in the game and try to account and show how ES and actions people are taking will or won't cause harm/benefit.
- No explicit value may result in NO assigned value.
    - This has already happened in policy a lot. Other things without value, despite having known importance, get cast aside because people/policy makers tend to look at the bottom line. Things with no value are absent from the bottom line.
- In a benefit/cost analysis, we need to weigh ALL benefits and ALL costs, so let's try and do the best we can to bring all values to the table.

- People care about nature for a variety of reasons:
  - Material (ES category)
  - Spiritual/cultural
  - Ethical
- All of the reasons fit into the ES category!
  - ➢ What choices will people make when they think about the big picture? - This is an important question

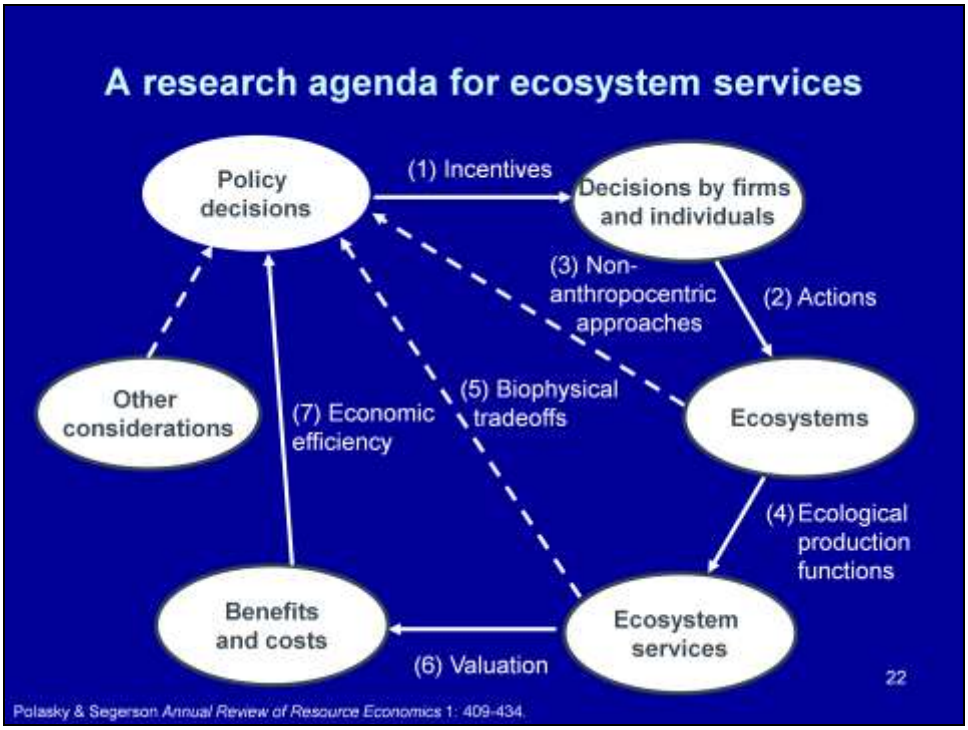
- Now, this presentation is about DOING the ES valuation, no longer concerned with the philosophy behind it.
- MEA has lots of lofty statements and "wish" science, but there is little evidence to complete the link.
- Frontiers in 2009 and show we can deliver the numbers and show the values.



In some areas, we are working to develop the link and show the numbers and deliver them as scientists.

Three main tasks to obtaining numbers:

1. Provision – This is a natural science task; change function and process to see how it changes provision. The physical quantities of goods and services being produced.
2. Value – This is an economic task. What is water quality worth vs. more agricultural production?
3. Policy – Can we align incentives for sustainable provisions for ES? This is an implementation provision.



- This slide represents a schematic of how things fit together. Again this is all about decision-making. This could be government or business. They provide framework and incentive for individuals and/PR firms that then take action on the ground and affect ecosystems function and process.
- (3) Involves more ecology based notions.
- (4) Going further - think about human action and the affect they have on ecosystems, and how does it affect provisioning?
- (5) Biophysical Tradeoffs
- (6) Going further with monetary terms, sometimes it stops here.
- (7) This is the last possible step; deciding where to stop is different and difficult, don't always have to put things in the same metric value. Sometimes dollar values are helpful, but maybe reporting in terms of tradeoffs is more advantageous for a given situation/decision-making process.

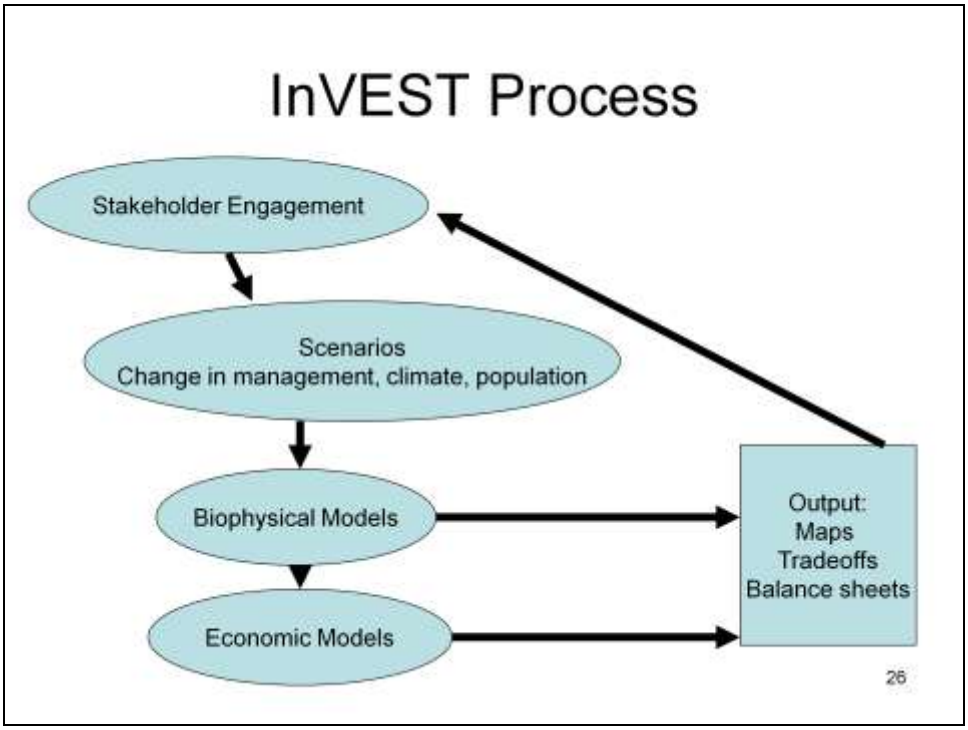
Again, this is a loop and each steps provides feedback to another.

- Lots of work on this and is happening through partnerships listed above. We've been working together to do a set of models in InVEST. Models are downloadable from the web with good users guide.

- InVEST – freely downloadable on the web, *see link above.*
- People who pick it up are from all over the world.

What is InVEST?

- The whole point of it is to think about the joint provisions of ES and what you do to a landscape.
- It is comparative.
- It is spatially explicit because it matters where things happen.
- Data use is tailored to the place and application.
- We want it to be flexible and transferable.



Stakeholder engagement

- First and foremost: what are the problems, concerns and policies? What is motivating the study of the issue? Here you need to talk to people on the ground.

Scenarios

- Must think about all the scenarios to consider.

Biophysical

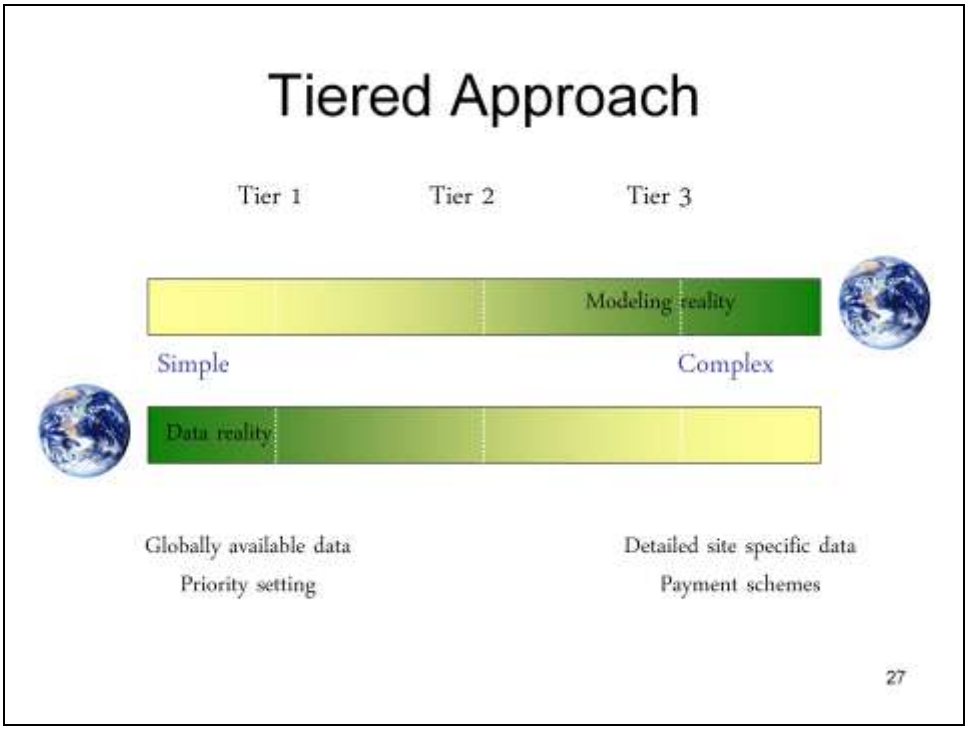
- Models a function of what you decide to do according to scenario.

Economic

- Models utilize more traditional economic outputs and valuation.

Output

- Can either be in biophysical or economic terms depending on the models.

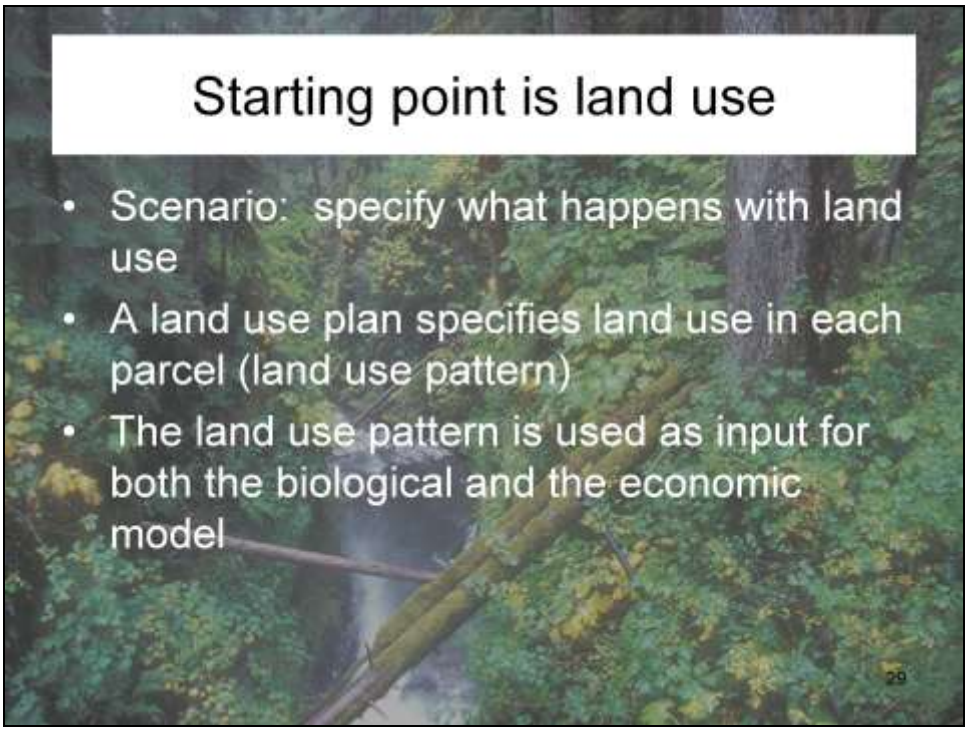


- These models aren't parameterized with some standard data. You have to pull together the data from your area of interest to run them. This presents a challenge that many of you are familiar with.
- A tiered approach exists which describes the complexity of the models.
    - Tier 1 is simple – maybe be best for policy comparisons
    - Tiers 2 & 3 are more complex –maybe best for assessing service payments

Where to put things? Spatial land management with biological and economic objectives

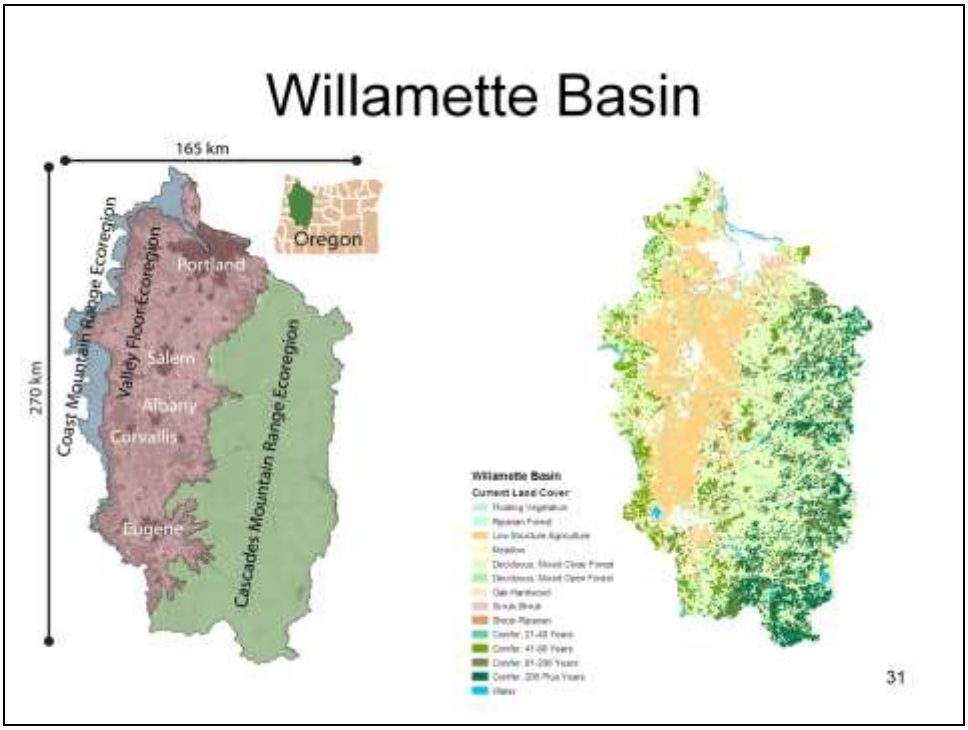
Polasky et al. 2008. Biological Conservation 141(6): 1505-1524. 28

- No we will run through a couple of examples that deal with the question:
  - What are key methods and results and kinds of things you get out of the valuation?
- Important to note that this example predates InVEST.

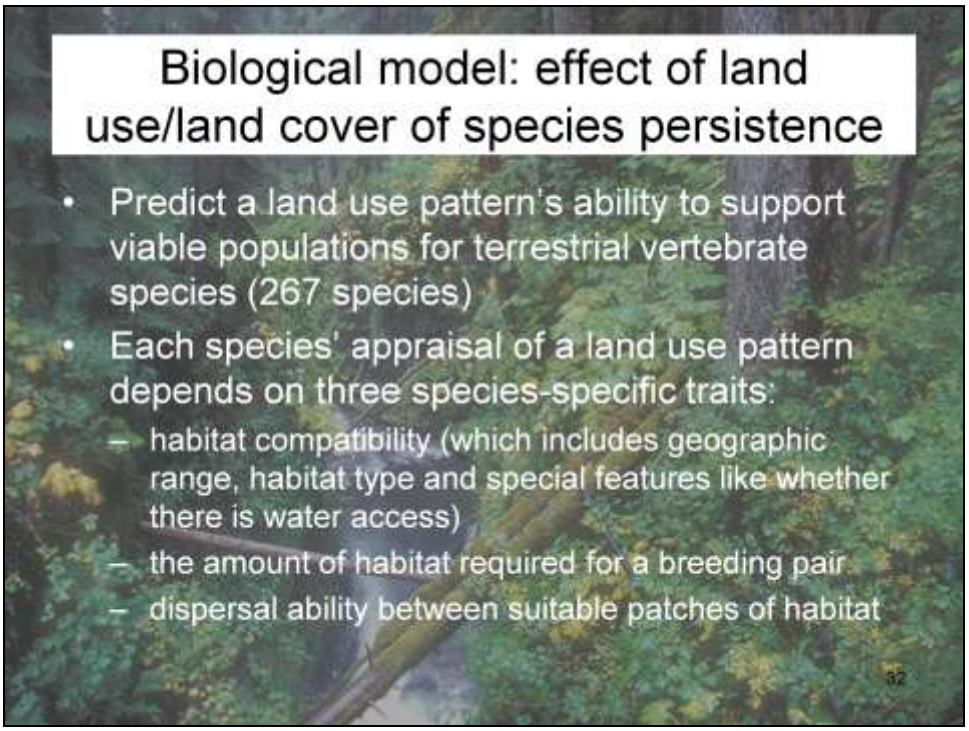


- Scenarios are the starting point.
- We use land use plans because they tell you what is happening across a large scale. It can be more broad than land use such as including climate change etc., but this scenario is only after land use changes.
- In this case we are concerned with land uses in the Willamette Basin. This is the input for all service provisions.
- Biologic – what are the biologic returns?
- Economic – what are the returns to landowners under different scenarios?

- We looked at 9 land uses, *see slide*.
- Oregon is unique that development has to happen in urban growth boundaries; this study is outside of those areas.
  - ➢ What are the land use alternatives in the Willamette Basin?

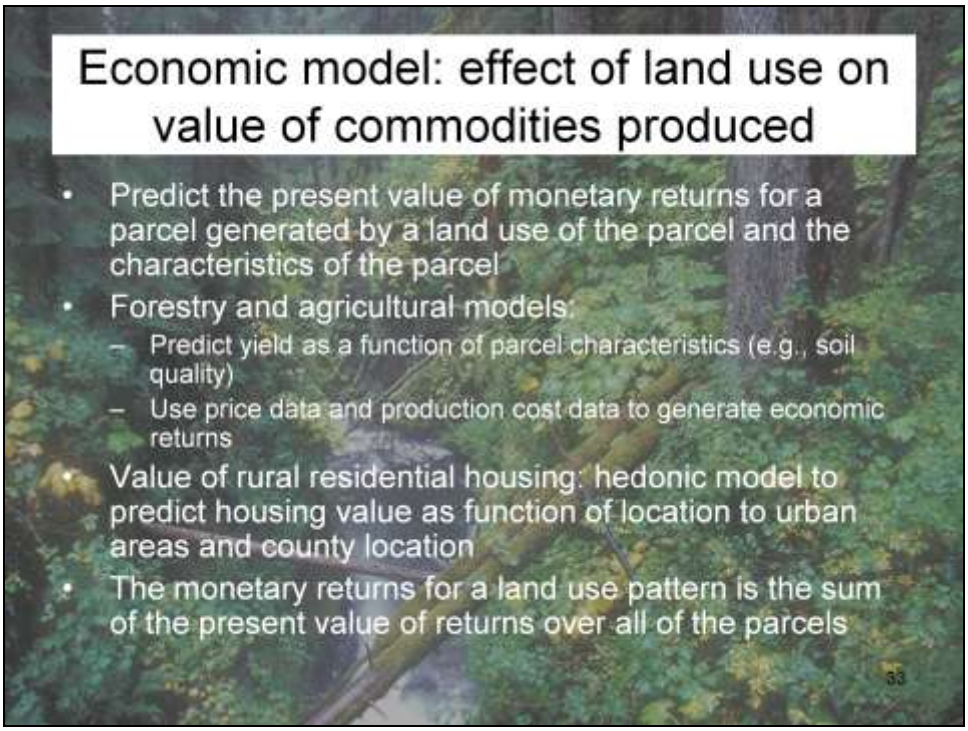


- Western Oregon
  - Small coastal range to the West
  - Valley floor contains cities and agriculture
  - Cascade Mountains to the East
- Cities are in white, study does not look at those areas
- Forestry is in green



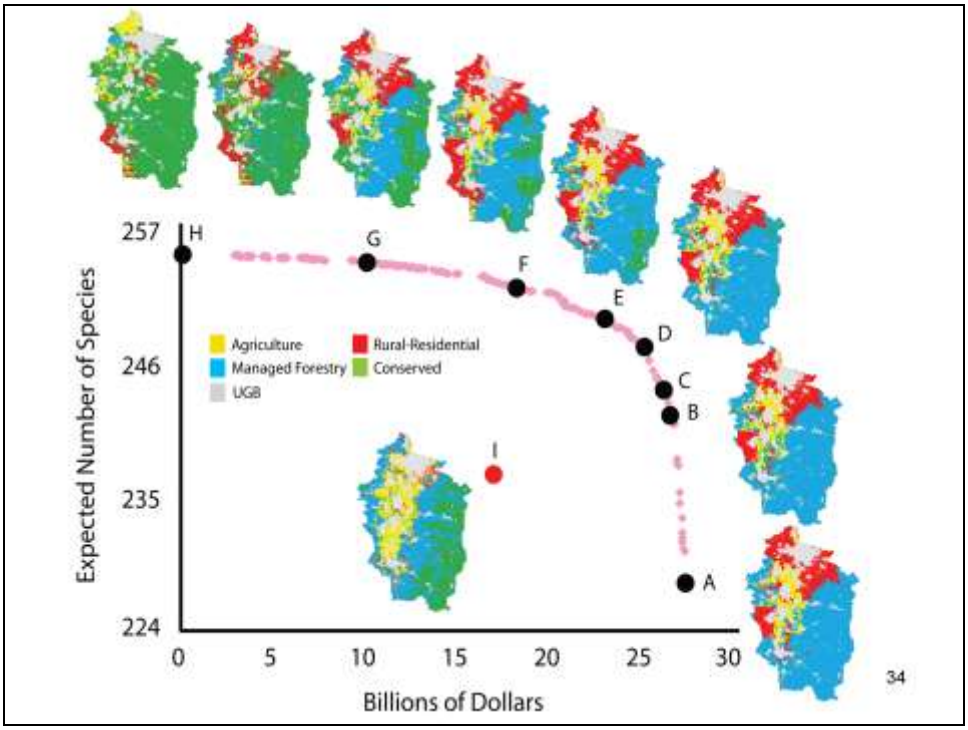
Biologic Model:

- This example was concerned with terrestrial species. It didn't look at each one, that would have taken forever so they developed three elements required to evaluate benefits to species as a function of land use
    - What counts as habitat?
    - How much do you need for a breeding pair?
    - What about dispersal considerations?



Economic Model:

- Land type will affect yield for each
- Agriculture: function of soil quality, slope, distance to market
- Forest production
- Combined the previous factors with price and market data and you get a economic value for services



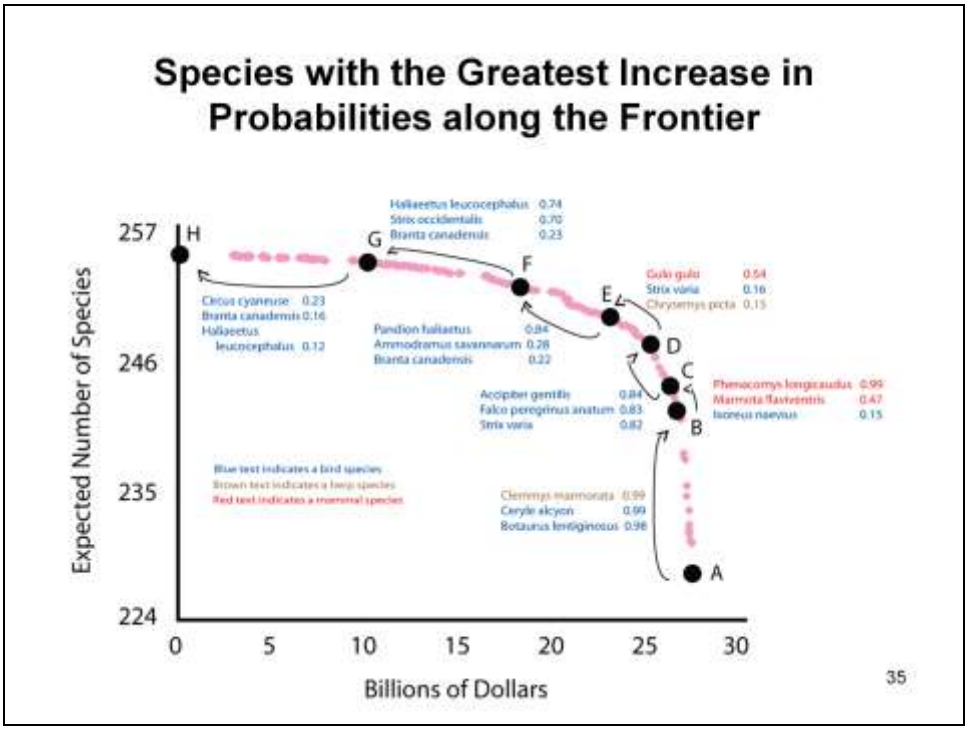
- This graph is a depiction of economic returns for agriculture and timber.
- It uses present value for ALL economic returns for the basin.
- Y-axis, how well species do, as you see not all will survive in the basin no matter what we do.
    - If we fix the biological score, what is the max economic score?
    - If we fix the economic score, what is the max biologic score?
- Production Possibility Frontier, standard economic theory
    - At spot B – there are very rare habitat types, many species respond very quickly. The difference between A and B is the large biologic benefit at a very small economic cost.
- Optimization people indicated that this is a nonlinear integer programming problem so to simplify it they made it linear which means prices were held constant.
    - Timber is one item where the price would not be the same because it is so special to this area.
    - In a later study where they were interested in scoring the landscape they include models of price changes.
- Point I is the current score. The debate is between jobs and environment but as we can see from the graph, we are not even at that point yet. They can still get a lot

out of the land and produce the same amount of biologic and/or economic score. Lesson is that we can do better on both dimensions.

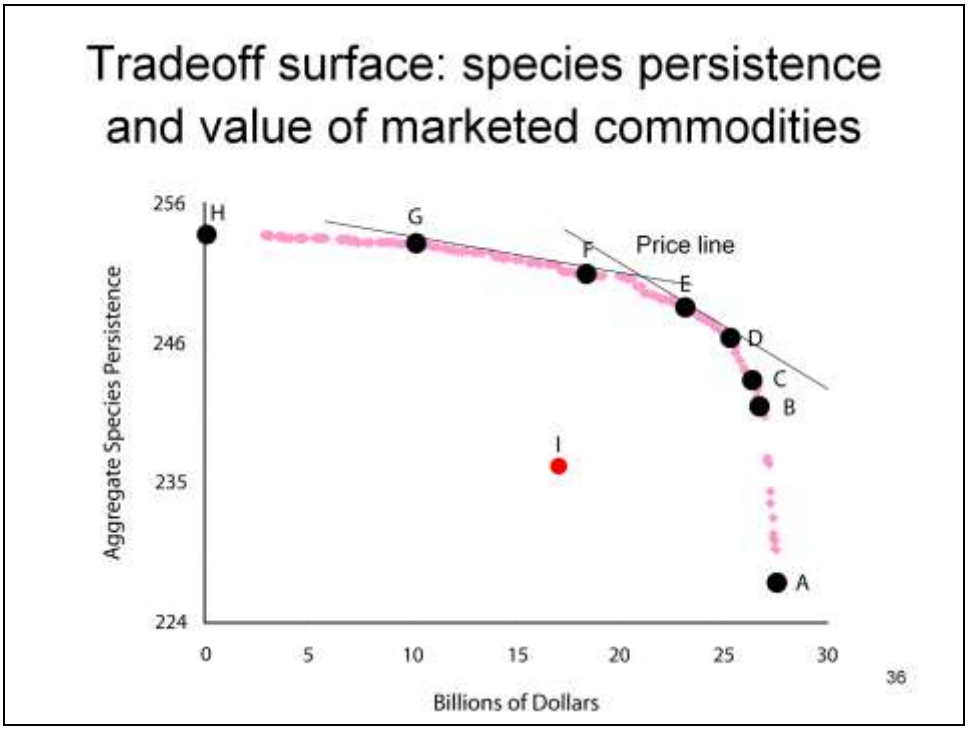
- Points E, F, G, to H are for species that need lots of space to thrive, i.e., spotted owl.

Note:

- They are analyzing this basin as an island, but it is not in reality.
- From this, we see the motivation to care about the services. In this model, it isn't just about the species count, we do care about other services like pollination and soil etc… they are all responsible for production of ecosystem and should be considered.



- Besides doing the aggregate, this shows the biological side.
- This graph list some species that changed the most at various points.
- Change from F – G is the most important for the spotted owl.
- Other species A – B can be saved more cheaply.



- Here's where tradeoffs come in – horizontal is in monetary terms, vertical is not – so how do we look at tradeoffs?
- What's it worth to you to save spotted owl? Most of these consideration are going to be political decisions, so let's bring the best info to the table to do this.

The Impact of Land Use Change on Ecosystem Services, Biodiversity and Returns to Landowners: A Case Study in the State of Minnesota

Polasky, Nelson, Pennington, Johnson. *Environmental and Resource Economics* 2011

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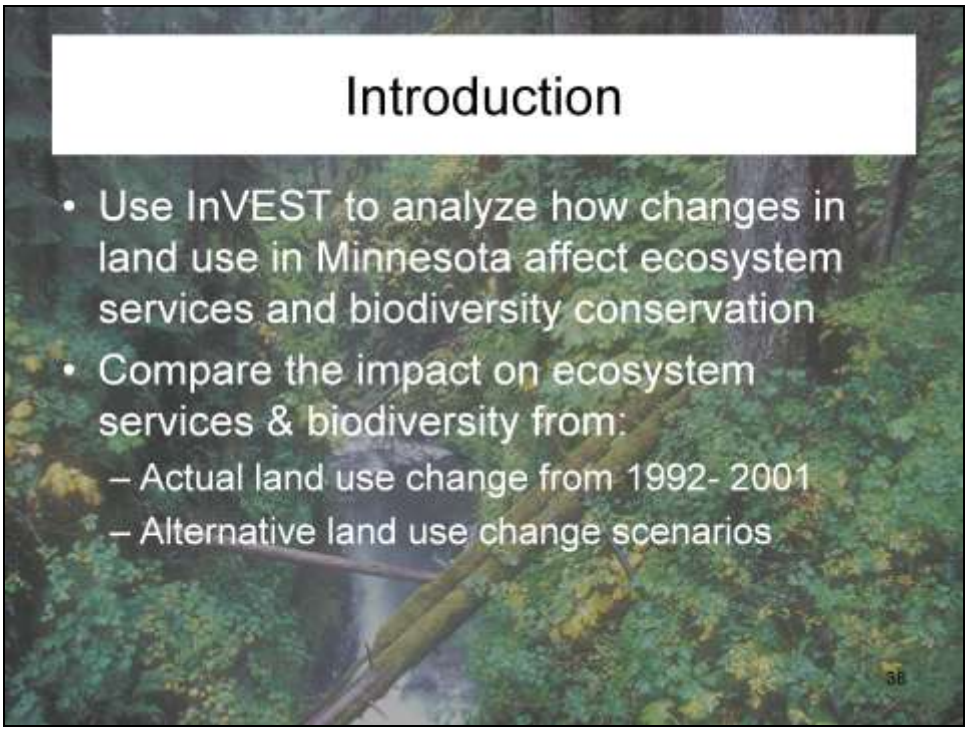
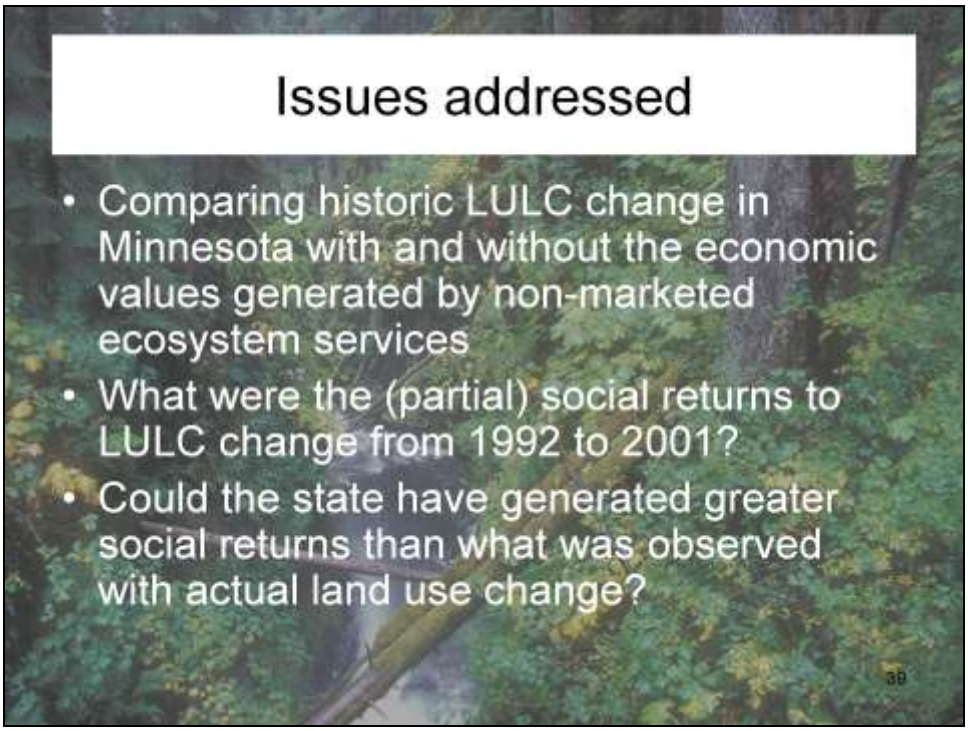


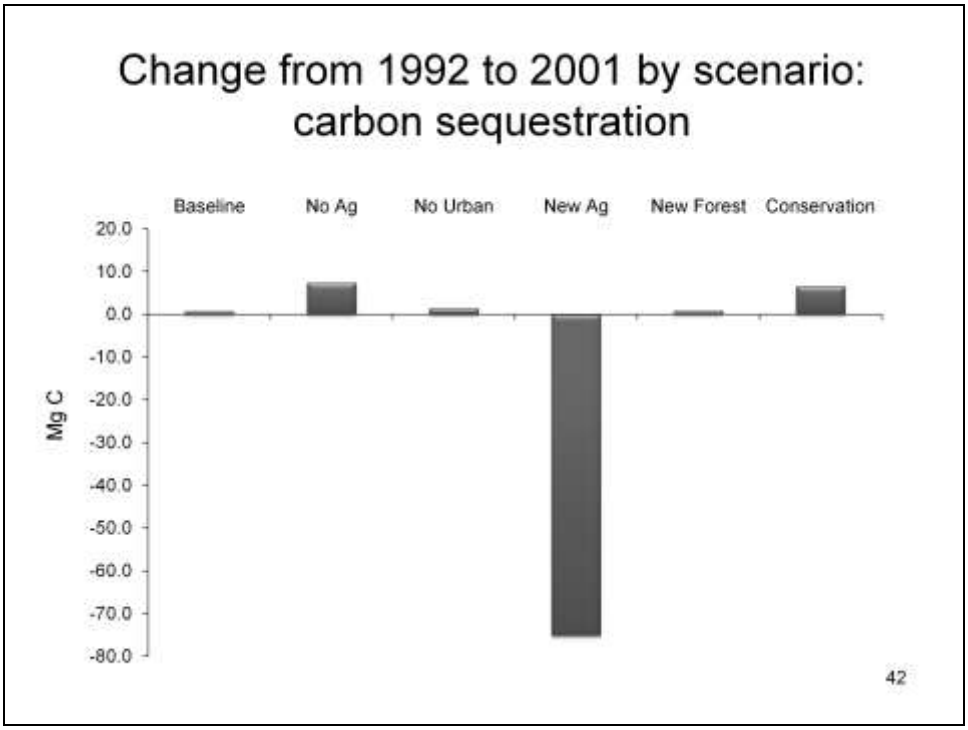
- This is set in Minnesota not Oregon.
- Still does not have full set of services in here; they are gradually adding them in. Pollination is one that is not included.



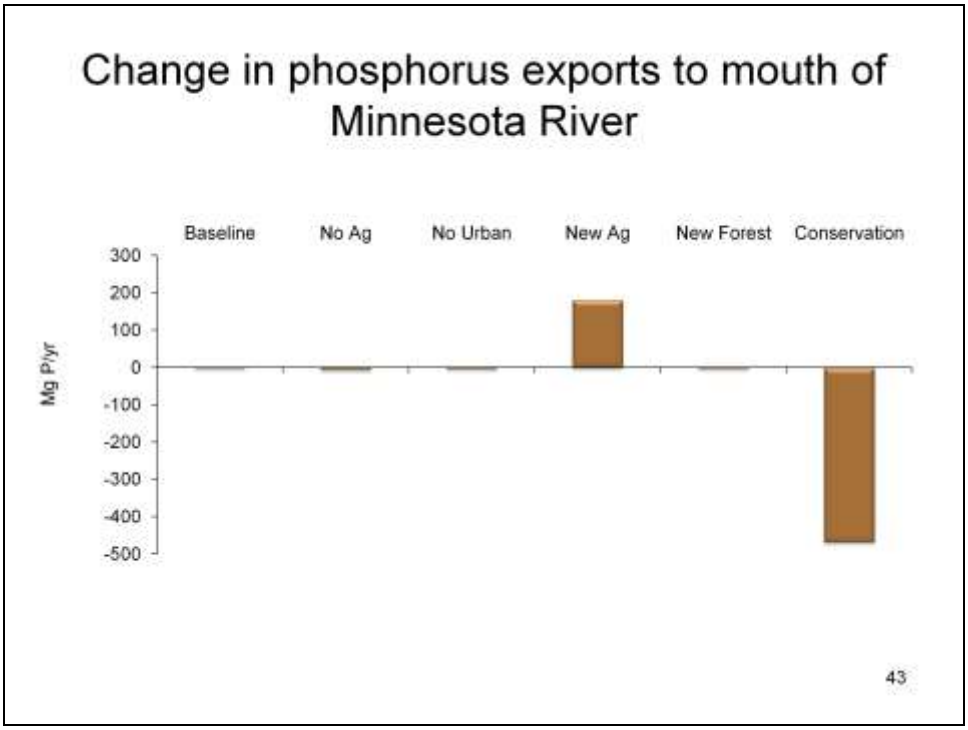
- Both market and nonmarket (carbon sequestration and water quality) addressed and how it relates to biodiversity conservation.

- This slide lists out some of the methods.

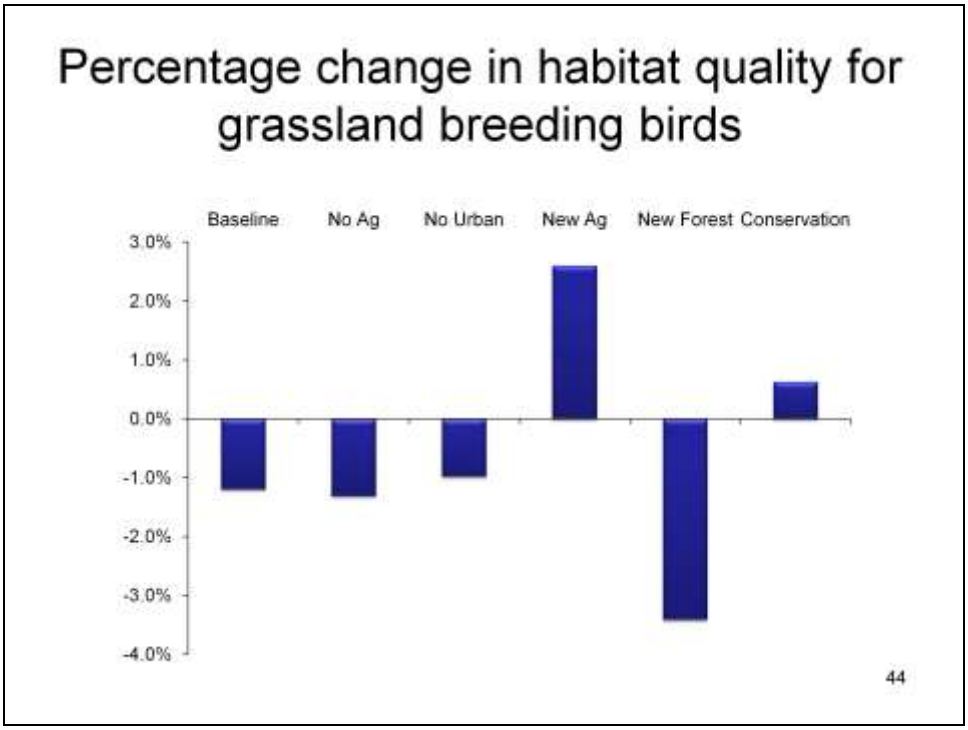
- The list of outputs that were examined, *see slide.*
- These are much simpler than before. It is a function of area as opposed to species. Not very nuanced; rather basic, i.e., is it grassland, yes or no? Etc.
- Non market services.



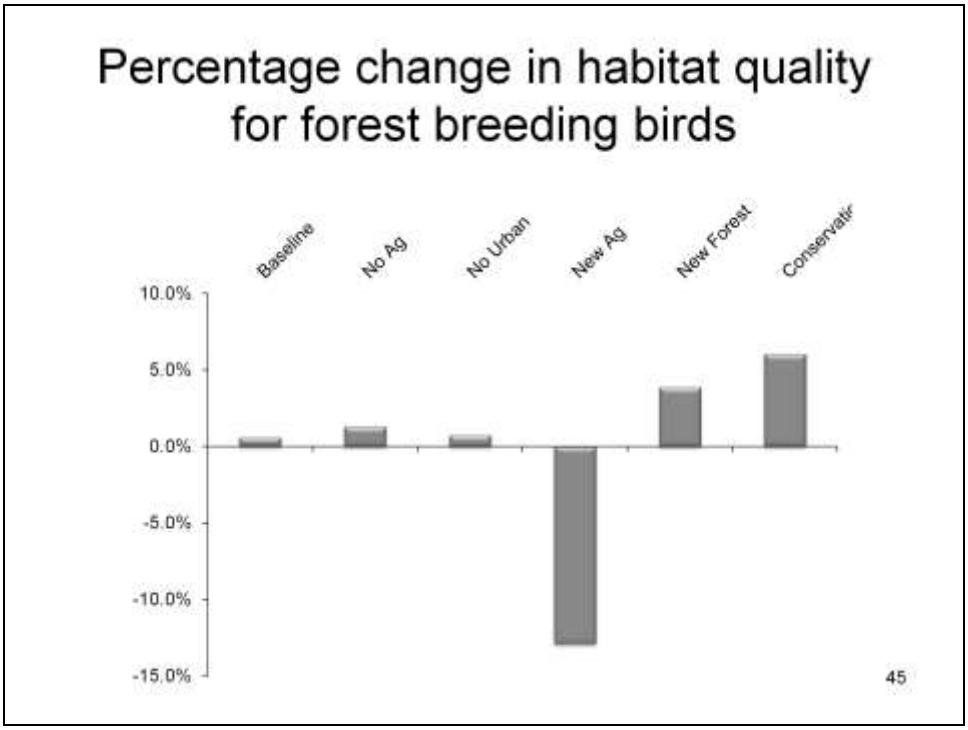
- This slide examines how carbon sequestration changes over time. Lots of forests maturing so if there is a big pulse of new agriculture then there is a new pulse out of carbon, *see slide*.
- Should you get rid of one of these? Answer is confusing; it does not change relative ranking across scenarios.



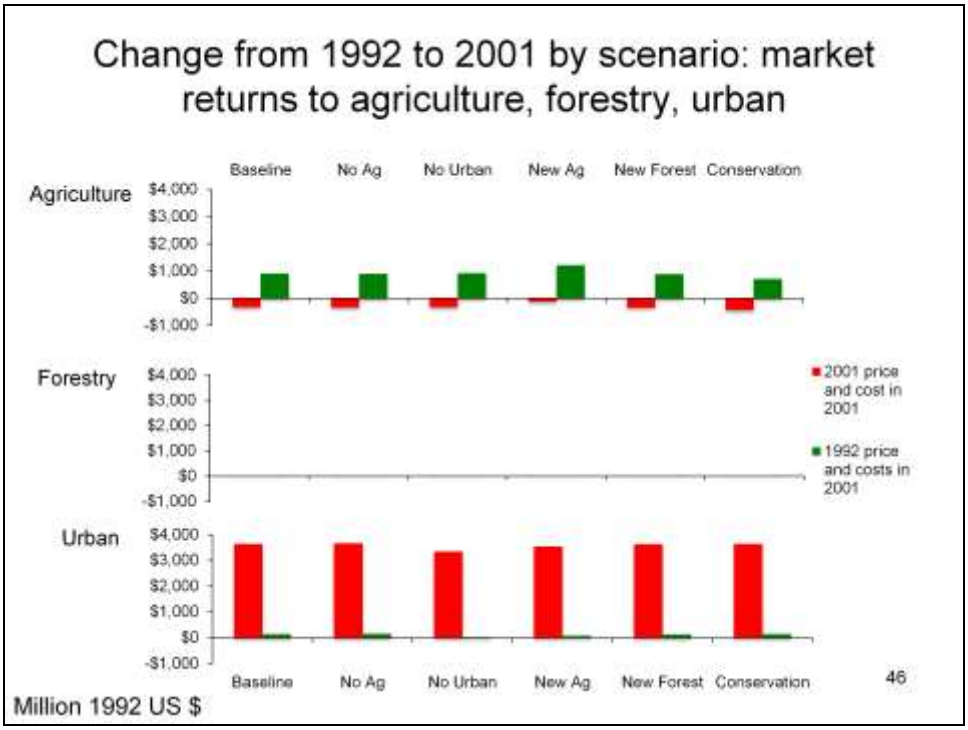
- This is the measure of water quality via phosphorous output.
- If you expand agriculture, then you get more phosphorous output.
- Not much change in others besides conservation, which creates a large surplus.



- One place where expansion of agriculture is good: pasture birds.



- Opposite is true when you look at forest birds.



- Actual prices in red versus no price change in green. No price change reflects the change from land use.
- Prices dropped and cost rose between 96-01 for agriculture products. Urban and forestry prices rose.
- Values of houses went up; they kept 1992 prices and saw smaller outputs.

Annual value from land use change scenarios 1992-2001

	Actual land use	No ag expansion	No urban expansion	Ag expansion	Forest expansion	Conser-vation
Change in total value: carbon, water quality, ag & forest production, urban using actual prices (M1992 $)	$3,328	$3,407	$3,040	$2,742	$3,300	$3,380
Change in returns to landowners: ag & forest production, urban using actual prices (M1992 $)	$3,320	$3,343	$3,027	$3,418	$3,292	$3,221

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- Top row looks at change in total value as value of water quality and carbon changes.
- To get valuation:
  - **Carbon**:
    i. Could look at prices for carbon markets, but that has its limitations. Chicago Climate Exchange was functioning, now it no longer exists. In 2008, the US voluntary market was trading for $2/ton; in Europe was more like $30/ton. Carbon is global, does not matter where it is emitted. The institutional details are affecting price so instead, this study looked at "social cost of carbon." What do we think an increase will do in terms of climate change and other social damages? IPCC and others have looked at this. This study used mean value which at the time was $43/ton for carbon and $14/ton for CO2
  - **Water**:
    i. This study used a prior study that asked people what they would pay. Recognize that the question is not the best, but it was "convenient" for the study.
- Real Values – there is a real value according to people living in society, but how do you get it?

- The difficulties come with the aggregation of perceptions. There are lots of fairness and equity issues, good discussion topic because there is no quick answer.
- If you expanded agriculture, landowners are happy because of market return but give you the worse value for biologic component.

Modeling multiple ecosystem services and tradeoffs at landscape scales

Nelson et al. 2009. Frontiers in Ecology and Environment 7(1): 4–11.

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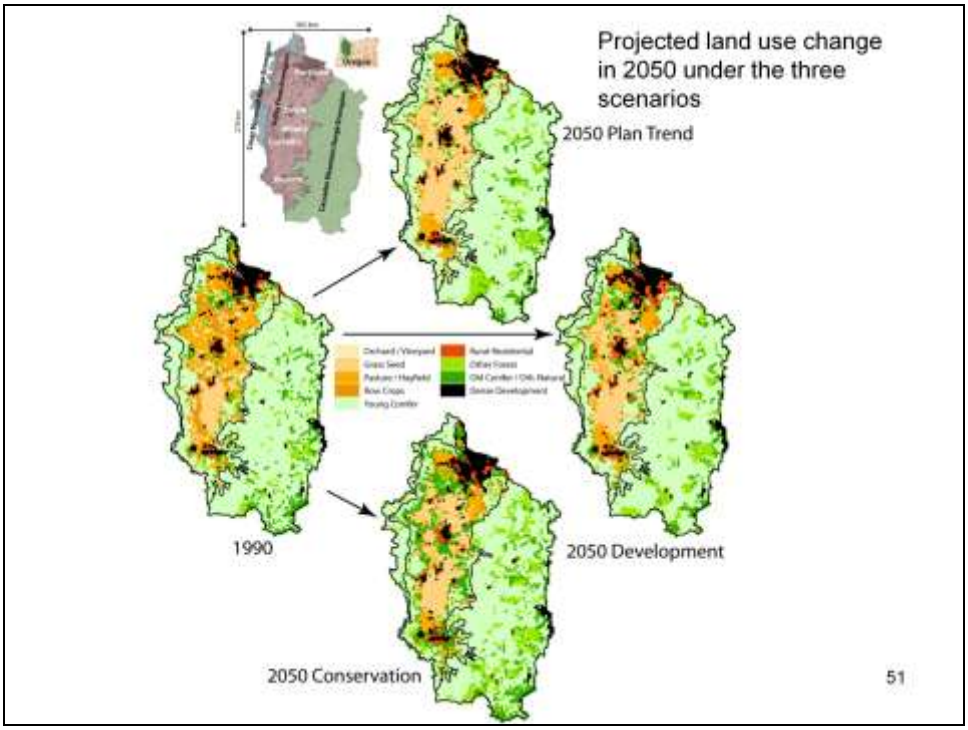
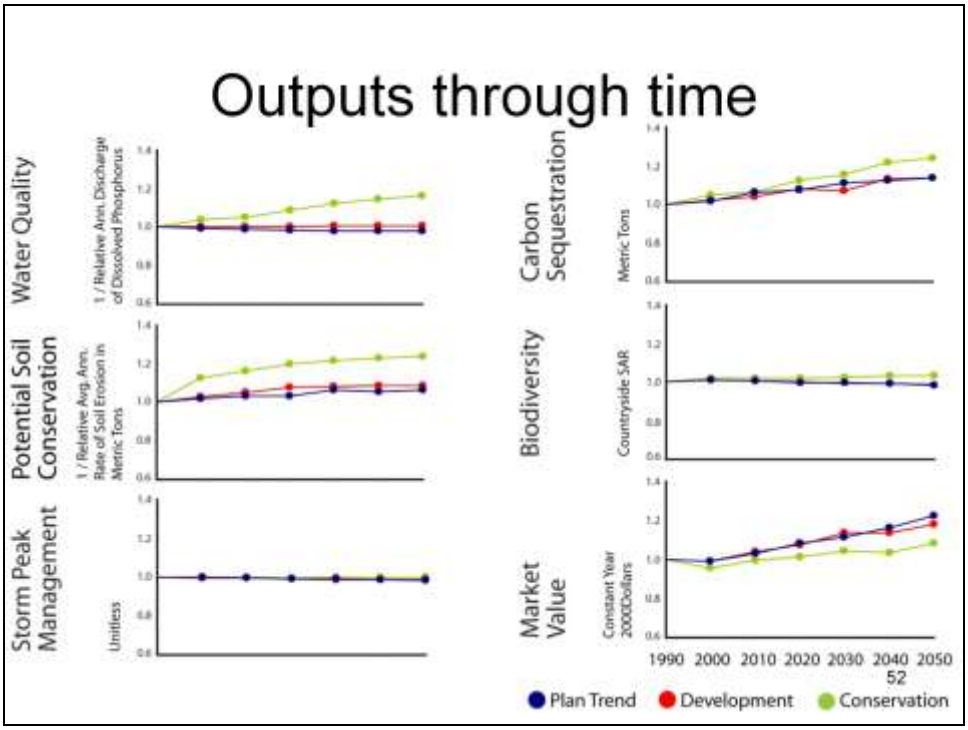
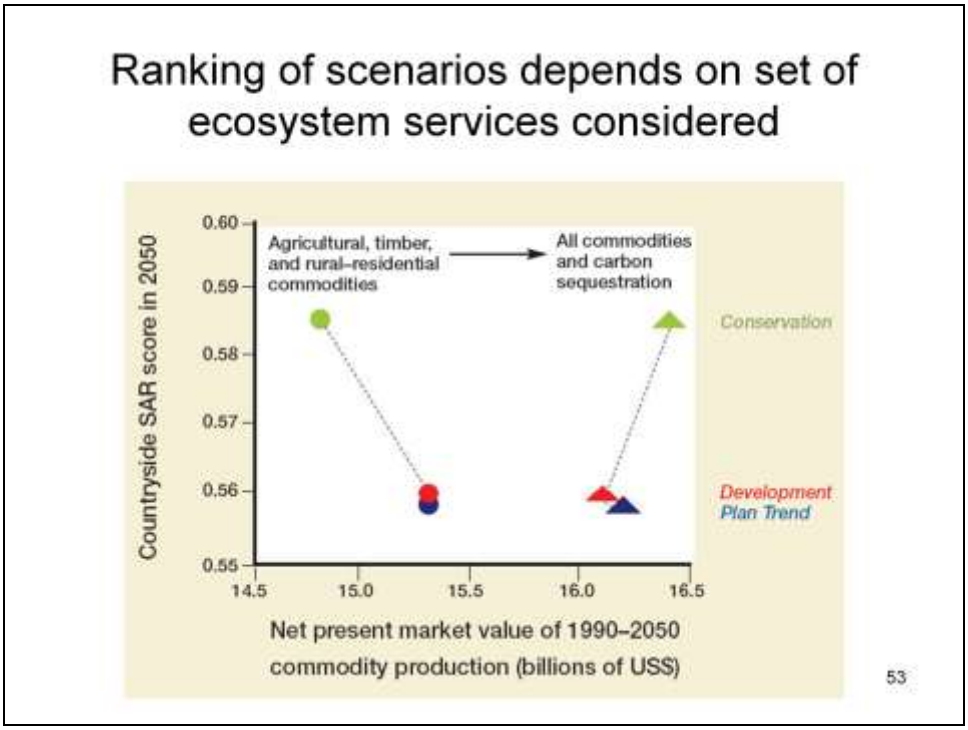
- Study takes place in Oregon.


Modeling multiple services under alternative scenarios
• Model outputs: service provision and biodiversity
– Water quality
– Storm peak mitigation
– Soil conservation (sediment retention)
– Climate stabilization (carbon sequestration)
– Biodiversity (species conservation)
– Market returns to landowners (agricultural crop production, timber harvest and housing values)
60



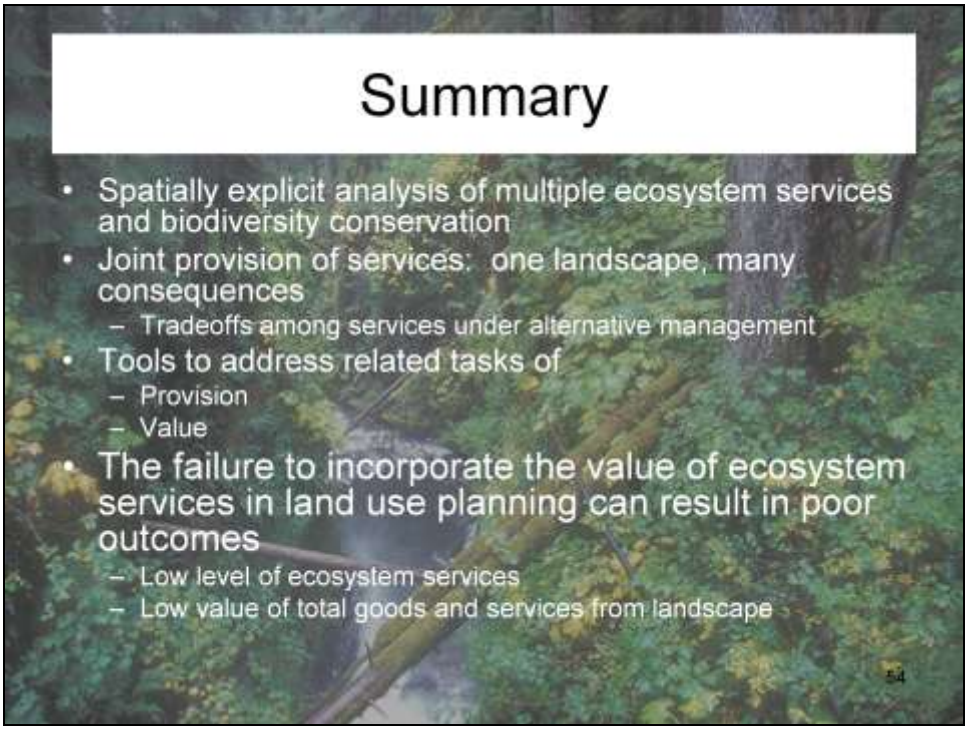
- Looked at scenarios discussed with people in the area.
- These are the consequences through time for a number of services.


Outputs through time
Water Quality
1 / Relative Ann. Discharge of Dissolved Phosphorus
Potential Soil Conservation
1 / Relative Avg. Ann. Rate of Soil Erosion in Metric Tons
Storm Peak Management
Unitless
Carbon Sequestration
Metric Tons
Biodiversity
Countryside SAR
Market Value
Constant Year 2000Dollars
1990 2000 2010 2020 2030 2040 2050
52
Plan Trend
Development
Conservation



- What is viewed as a good outcome for society? The services you include and the services you ignore have an effect.

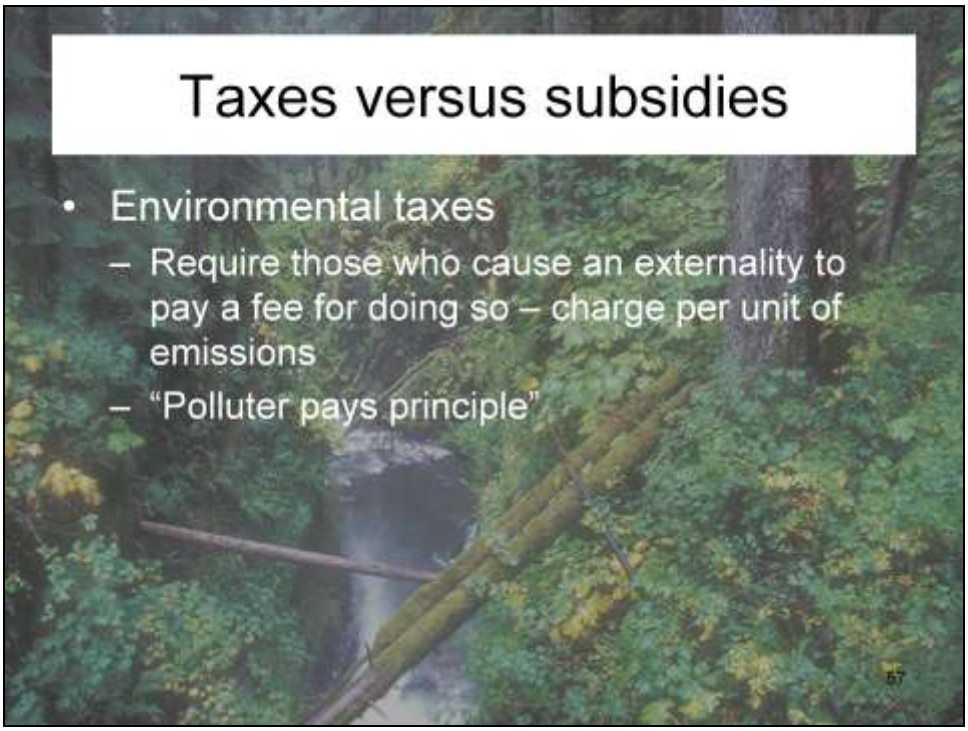
- What if you could pay for ES, pay for carbon?
- Second line depicts what happens: there are no longer the classic tradeoffs.
- Lesson:
  - The rules of the game and/or incentives (paying for carbon) really change the scenarios.



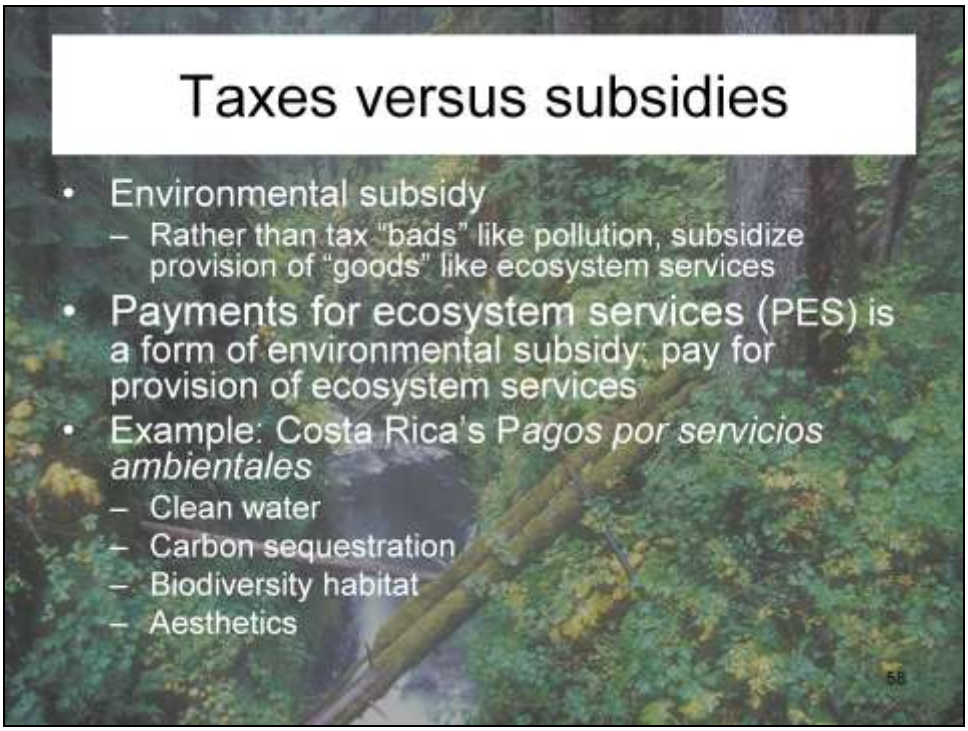
- Even InVEST is guilty of looking at an incomplete list of services.
- Carbon and water quality are very important to include. In certain areas recreation are more important to include.
- Lesson:
    - We get ourselves in trouble when we do not look at the full list.

- How do we fix the problem and provide proper incentives for ES?

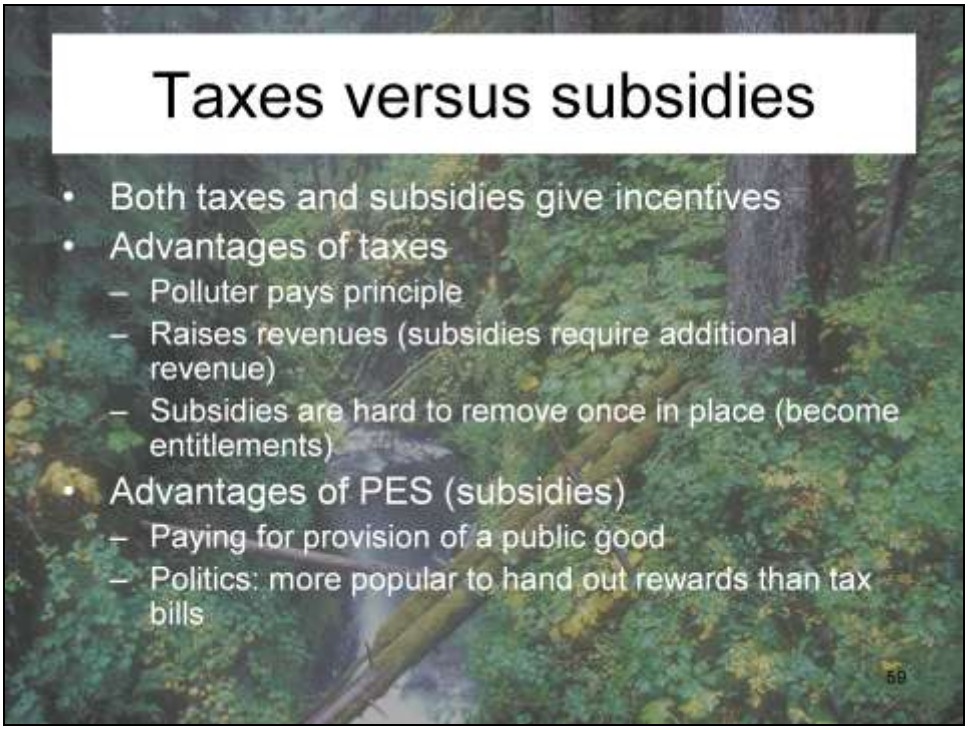
- This has been well-studied for a while. Focus has been on how to deal with externalities and public goods.



- Payment for ES (PES) dominates a lot of conversations of ES.
    - Makes sense to charge a person; that is what we do for pollution.



- In ES, we have not used the taxation approach.
- We think that ES are public goods, if they want them, we must pay land users to keep them instead of charging landowner for destroying them.
- There are lots of examples of subsidies being used: Conservation Reserve Program and Wetland Reserve Program – PES; Costa Rica PES pays landowners for four types of services, *see slide*.



- Do you think of this more as a land-owner responsibility or is it a public good?
    - This brings up a philosophic question about what is fair? Who takes on the responsibility for ecosystem services?
- In the case of pollution, the polluter pays penalties which then creates revenue that is available for later use.
- Subsidies are really hard to remove once in place, they become entitlements.
- There are advantages of PES:
    - If it is public good, and not fair for land-owner to have burden, then this is the way to go.
    - Politically more popular to have rewards than penalties.

Efficiency of incentives to jointly increase carbon sequestration and species conservation on a landscape

Nelson, Polasky et al. 2008. *Proceedings of the National Academy of Sciences* 105(28): 9471-9476.

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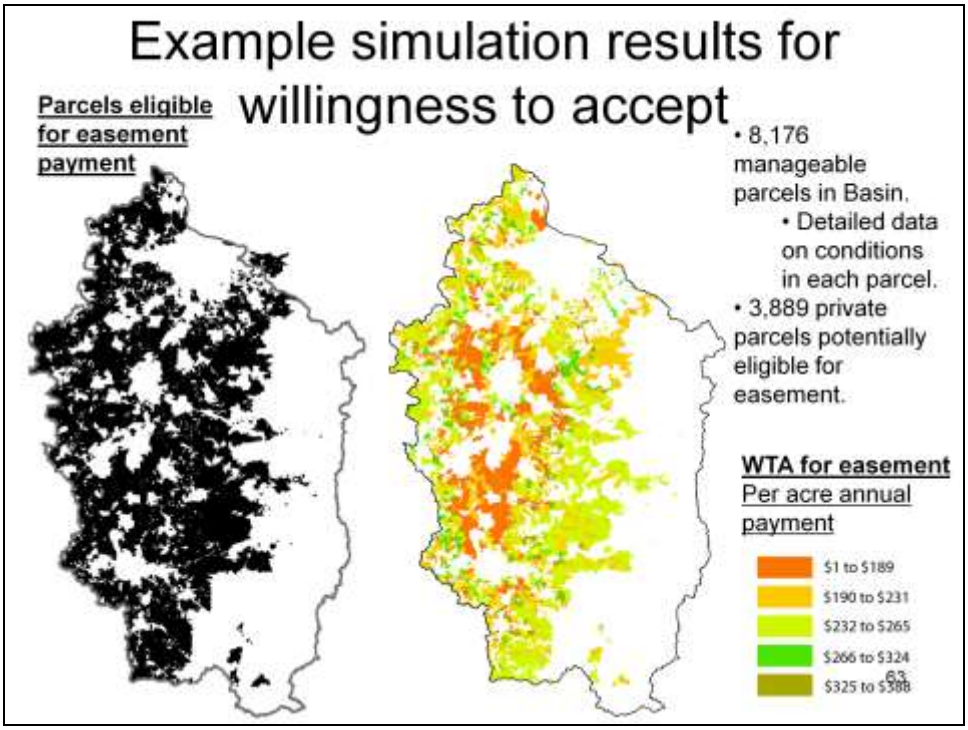
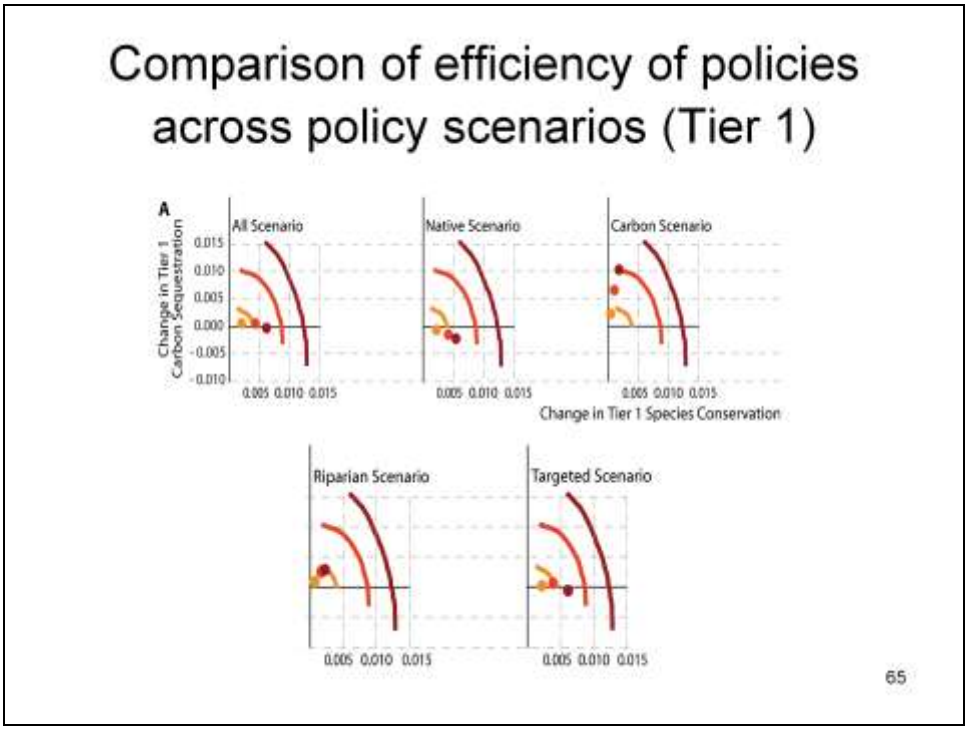
Efficiency of incentives to provide services
Analysis of incentive programs that pay for enrolling in conservation
How well do voluntary payment programs work?
Use data to built a statistical model of land-use change (NRI land use data 1982, 1987, 1992, 1997)
Use the statistical model to estimate parcel-level willingness-to-accept a conservation payment to enroll
Simulating the spatial pattern of conservation for a given policy
Score the landscape for species conservation and carbon sequestration
Compare outcome with the optimal spatial arrangement of conservation (efficiency frontier)
61


Efficiency of incentives to provide services
• Data on land-use change (NRI land use data 1982, 1987, 1992, 1997)
• Estimate relationship between economic returns in various activities and probability of land use conversion
• Use the statistical model to estimate parcel-level willingness-to-accept a conservation payment
• Simulating the spatial pattern of conservation for a given policy
• Score the landscape for species conservation and carbon sequestration
62

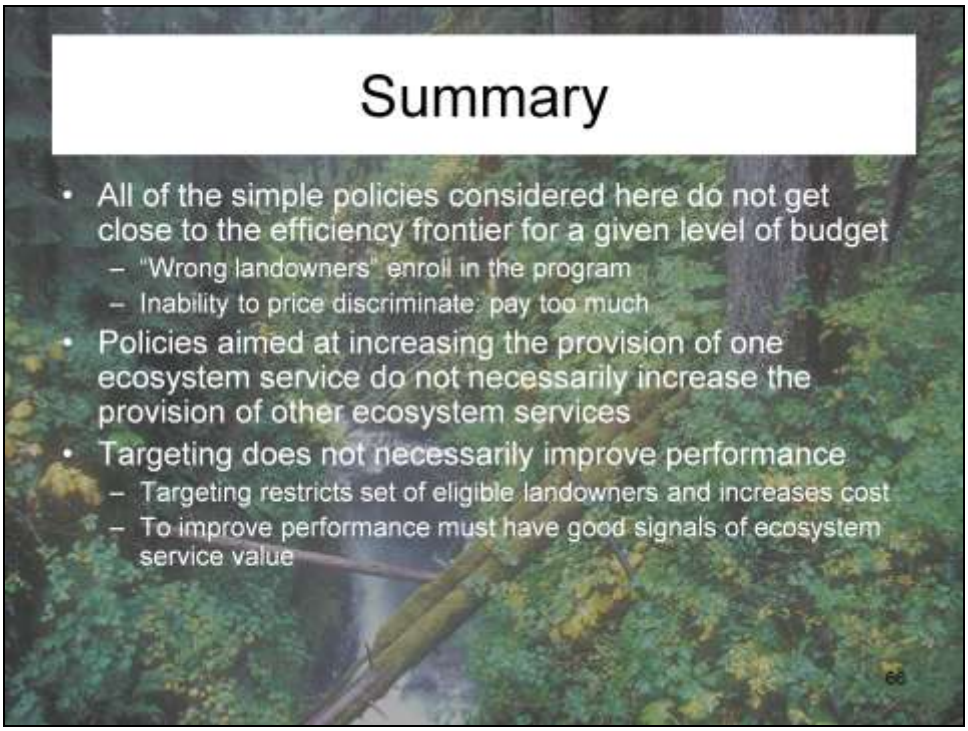


- How much can you pay someone to get into a conservation program?


Policy simulations
• If conservation payment offered to landowner exceeds WTA then landowner enrolls in the conservation program
• Policy scenarios:
– All: all landowners eligible for payments
– Native: restrict to land in certain habitat types
– Carbon: restrict to land that could convert to forest
– Riparian: restrict to land along riparian corridors
– Targeted: restrict to land shown by prior analysis to be important habitat for species of concern
• Run simulations with various budget levels ($1 million, $5 million, $10, million)
64



- Dots are voluntary frontiers and show that we are not close to the frontier and not where we want to be.
- This was a targeted scenario, meaning that the study picked out important habitat types. Shows that scenarios did okay for conservation, but not for carbon.



- <u>Targeting:</u>
  - If you restrict eligibility to those land-owners that have land with the highest ecological value, i.e., riparian buffer, it is beneficial in the sense you increase biological benefits, but you also restrict acreage and increase the cost of the program.
- Need a good measure of ecological performance for targeted approaches.

Implementing Optimal Conservation

Polasky, Lewis, Nelson, Plantinga, Working Paper

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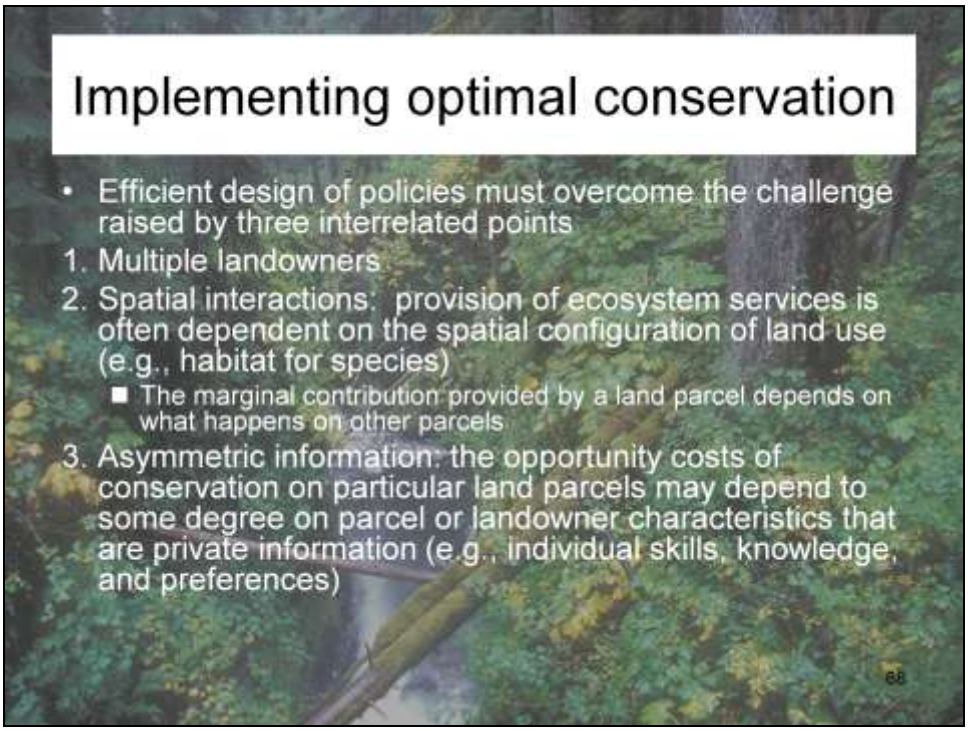
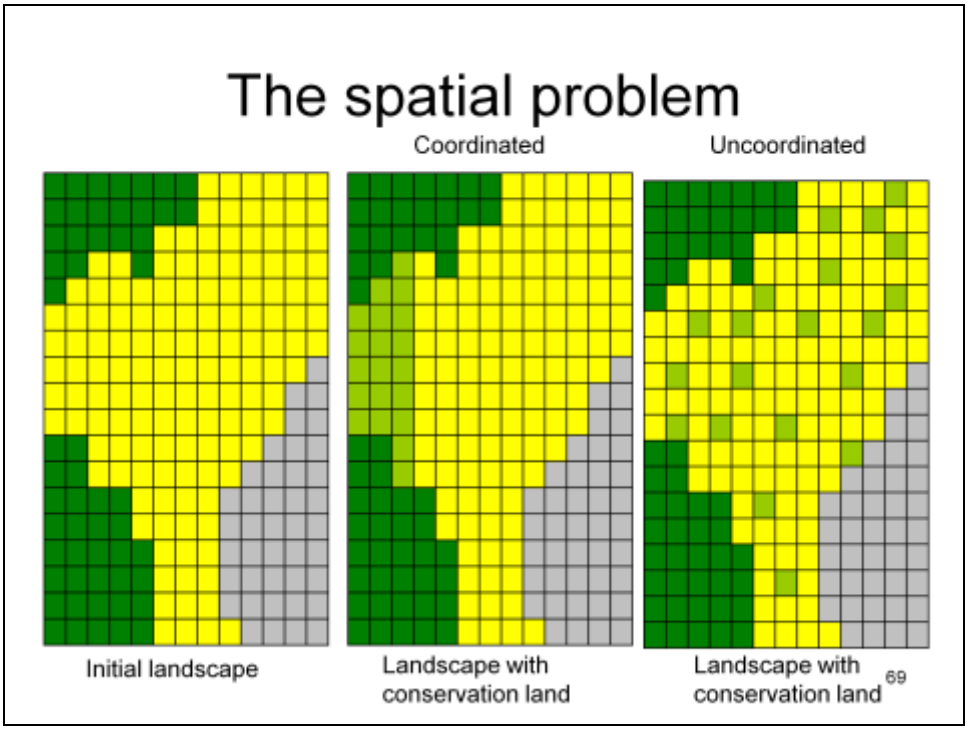
- There are some slightly less simple policies that work really well.



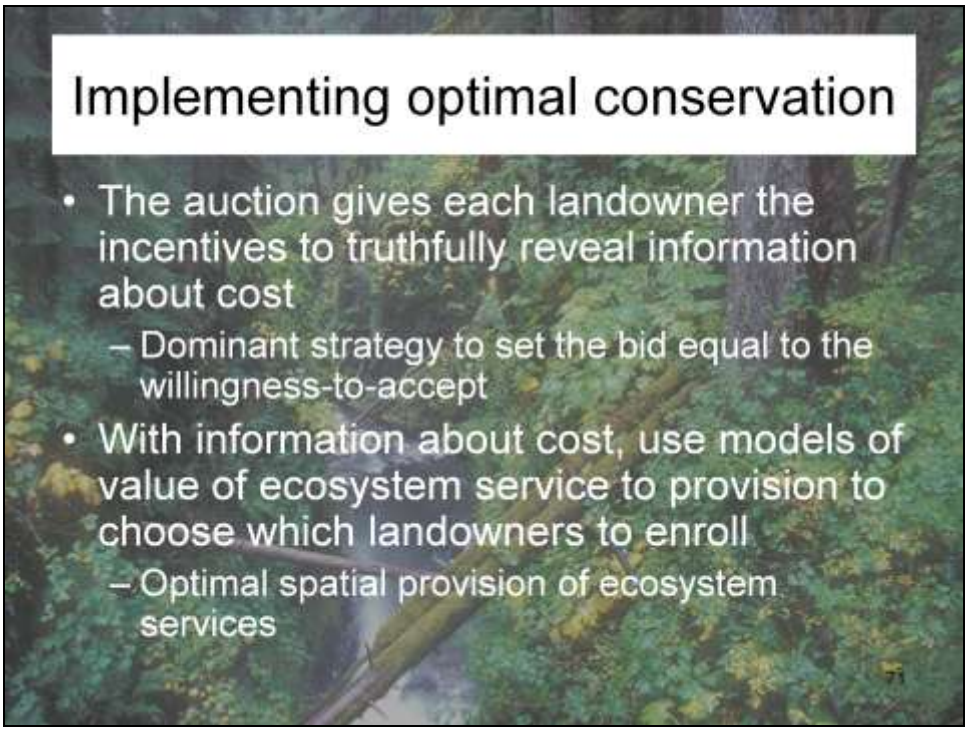
- There are some less simple policies that have more optimal outcomes.
- Landowners have different values (personal or otherwise). One might value the identity of being a farmer while others may be happy to enroll for any reason.

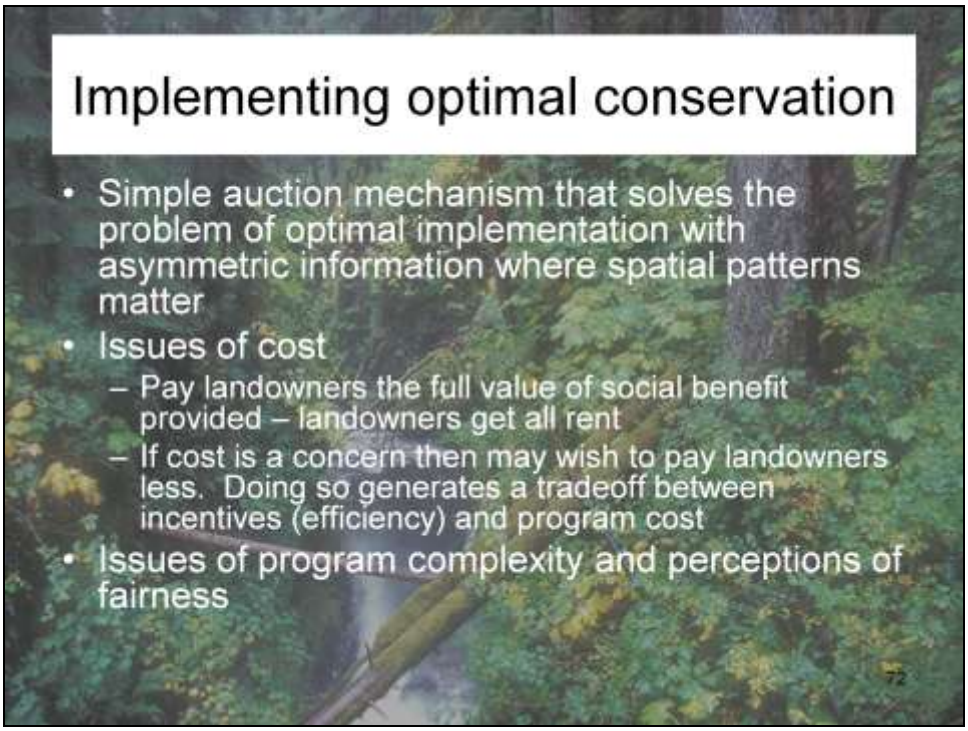


- This helps people to answer honestly regarding cost info.
- Then you can use that to decide which landowners should be enrolled.

➢ How do you solve the spatial problem optimally?

- This helps people to answer honestly regarding cost info.
- Then you can use that to decide which land-owners should be enrolled.


Implementing optimal conservation
• The auction gives each landowner the incentives to truthfully reveal information about cost
– Dominant strategy to set the bid equal to the willingness-to-accept
• With information about cost, use models of value of ecosystem service to provision to choose which landowners to enroll
– Optimal spatial provision of ecosystem services



- Simple auction mechanism solves the problem.
- This is not an insurmountable problem, it can be tackled.


Valuing nature: Summary, current status, and what needs to be done
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- Good news: We know a lot already. Through thoughtful valuation, we can do a fair amount

- Bad news: We do not pay attention, i.e., we know a lot and we do not do anything about it.

Two sets of challenges:

- Knowledge: modeling, etc…
- We need to try things; we should put things out there and see what happens. Also, we should see what works and what impacts those actions might have.

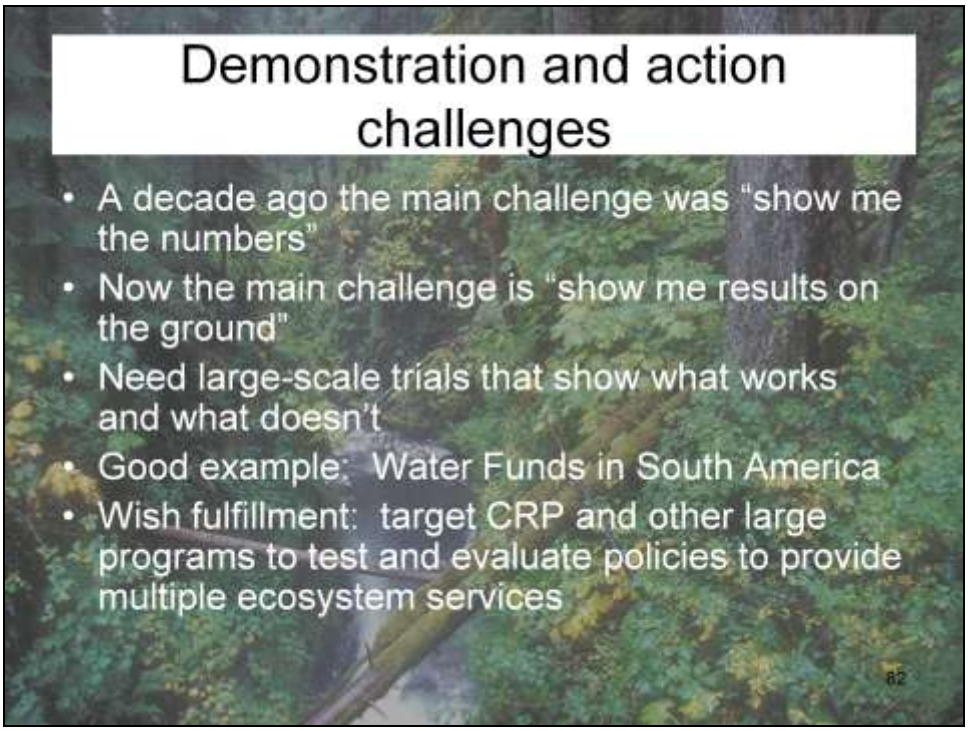

Technical and modeling challenges (1): quantification
• Social-ecological systems: dynamic and interconnected
• Do we understand systems well enough to predict short-term and long-term consequences of management actions on services?
• Particular challenges
– Incorporating variability and uncertainty
– Thresholds and regime shifts

- Carbon and tilling – different studies about what sequestered more carbon. Once they figured out that it does not affect carbon, it was hard to take away mechanism that already begun paying farmers not to till.

- It is hard for economists to assign a value to this.

- Interesting work at a macro scale, *see slide*.
  - ➢ What is a good set of sustainability metrics?

- There are important questions about distribution and equity.
  - ➢ How do we weigh these tradeoffs?



- Fundamentally it is a question of demonstration.
- A decade ago it was about the numbers, now we need large scale trials to show what works and what does not.
- CRP – conservation reserve program.


Moving ahead
• We do not know enough BUT…
• We know enough to improve on current performance
• Pressing need to begin to mainstream ecosystem services into societal decisions
• The long road rather than the quick fix:
– Better science to improve understanding
– Better institutions/policy that reflect values
– Adaptive process that learns through time
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Thank you

Seminar 2 Discussion Synthesis

May 5, 2011

This document is a synthesis of important topics and questions discussed during the question and answer period immediately following Dr. Stephen Polasky's presentation. Please keep in the mind that the following is only a recap and speaker identities have been removed, except for Dr. Polasky. We hope that the following notes and discussion questions will be used as resource to advance further discussions about ecosystem services.

Below you will find a summary of specific key questions and topics that were covered during the Seminar discussion.

Question 1

Going back to the auction example to get landowners involved in conservation programs – How could you bridge the gap between what landowners want for ecosystem services and how much existing programs pay for stewardship?

DR. POLASKY

- Trials are often theoretical, but there are some examples e.g. Australia. This is a hard question to answer because there may be critical landowners that aren't currently enrolled so how much more would you need to pay them? If you want truthful revelation, then the auction method is a good way to know range rather than just if it is worth $X.

Question 2

Do InVEST models include social elements or just ecological elements?

DR. POLASKY

- For the most part, they are economic and environmental only. They are really based on what the market return would be. One way to get at this is to use observed decisions of what people actually do. I'd love to bring social components into it and I think we're at a point where this in now needed.
- National Center for Ecological Analysis and Synthesis (NCEAS) is working on cultural services now, but do not know the outcome has been. There are other examples of those that have added in social services that are outside of InVEST, but parallel and on equal footing.

Question 3

I am surprised by the notion that we do not have to do much more research. Would you say the same thing about the marine environment?

DR. POLASKY

- NO – the statement about implementation vs. science is relative. We do not know everything about science, but on a general level, we know things that are going to be better or worse for the environment, for ecosystem services. What I mean to say is that it is not a big jump to say nutrient management will improve downstream quality. Maybe not the exact amount, but the rough amount we know. So let's take what we know and start putting it into action – that is why I say implementation is the more urgent need right now.

Question 4

Oregon and Minnesota both have huge recreation industries, is it worthwhile to add this into the models?

DR. POLASKY

- Yes, it is very important. In some ways, we should be further along because there is well developed recreation literature for non-market values. The problem for InVEST, is that they are all tier 3 models or beyond. They require careful analysis of who is visiting sites, where they come from, etc. which is data we do not have yet. So we can do a simpler model to get a base value and then incorporate the new data once it is available.

Question 5

What has the reception been of this type of framework, the ecosystem framework, by decision-makers? Is it different depending on scale e.g. local, regional, marine or terrestrial?

DR. POLASKY

- My sense right now (I am biased); I am overrun by people who are interested right now. The interest is in finding more about it, there is a lot left in translation to doing it on the ground. People are into finding out what it means and what it means for their program from all scales, i.e. county commissioners to international level.
- I tend to be well-versed on domestic. The Natural Capitol Project is international; they have demonstration projects on certainly every continent: projects in Ecuador, Tanzania, South Africa, Brazil, USA, and South Africa. South Africans have great capacity for ecosystem services. One program, I think it is called Work for Water, is a great example.
- In Costa Rica, I gave a seminar for economists. They are the ones who pioneered this program for ecosystem services and are way further ahead than we are.
- Australia has a lot of programs. Lots of activity everywhere. China Indonesia.

PARTICIPANT

- My experience is with California Assembly Bill 32 Climate Program. We see benefits to the atmosphere through emission capture. In that context, officials have had enough confidence in regulatory design that they accepted it at the State scale while the federal level is less confident. I think we will see a watershed event with the launch of the cap and trade program.

Question 5, part B

In terms of receptivity for decision-makers, what are the key ingredients of success? What has been challenging to this? What helps policy makers accept this ecosystem services approach?

DR. POLASKY

- A lot of this starts with the recognition that this is important. It has to come from the people in the system, whichever system that might be. I work with EPA and now they want to transition from the risk paradigm to a sustainability paradigm. Their science advisory board put together a document about this. This is an example of an internal change largely bubbling up from regional offices. They want to move beyond human health to ecosystem services and ecosystem health. There was recognition internally that this was important and now it is moving in that direction.
- The national program right now is facing some serious headwind with carbon skepticism. The downside is that I think it has gotten harder because of the politics surrounding climate change. This isn't true in a lot of other countries; Europe is full speed ahead.

PARTICIPANT

- I want to tell the story of not exactly a failure but not exactly a success either. We have been working with the government of Rio de Janeiro about having water users in a small area and subsidizing water uses in headwater. Did a lot of work on it, and gave them a few simple options and it has not happened yet. Not because it isn't a good idea but because of government inertia. Having the technical advisors available for 5-10 years for government makers is difficult. We need to look for enough champions to get issues through. There are so many other priorities in government that we are not only victims of opposition but also just of being too low of a priority.

PARTICIPANT

- Coming from the non-public sector approach, it seems like in several cases where there is something mandated and then people have to respond. For example, in Mongolia, the World Bank mandated that they write a payment for ecosystem services (PES) law. This may not be scientifically driven, but it sets up movement to do this.
- There are other social drivers at play. Val Chemical gave $10 million to TNC to develop ecosystem services for their own practices – this probably was not scientifically informed but based off of their own interests.

DR. POLASKY

- The classic model used to be that the private sector has to be dragged kicking and screaming and the public sector has to regulate; increasingly this is not what I see. Some of it is bottom line, i.e. with prices going up we will do X. But some of it isn't scientific or bottom line, it is more "this is the right way to do business." Corporations like the Dow Chemical Company (Dow) or even countries like China where if they decide they want to do something, it happens quickly. May be good, may be bad but it is QUICK, not like democracy.

PARTICIPANT

- Socio-Bosque in Ecuador, another example where the President mandated to set up Reducing Emission for Deforestation and Forest Degradation (REDD) for international community. It is in place and doubling in size, may not be good or bad but it is an example of democratic country where a strong leader got something done.

Question 6

That describes a common issue. I would be interested in exploring the tradeoffs that need to be considered, particularly in the Klamath. Do you think the watershed, basin management and the different organizations working in the Klamath are good vehicles for policy?

DR. POLASKY

- Well I work mostly in the Willamette, but I can speak to the Klamath a bit. It is interesting because they have had the water fights and it is very polarized.
- When I worked at the Council of Economic Advisors, I noticed that there are two explanation for why certain topics getting lost in the shuffle, either:
    - The issues is cold, not as important or
    - The issue is important, but not white hot.
- The Klamath is too polarized to do anything. It got so emotional that you couldn't have a conversation about tradeoffs. It is really important to have conversations then, but it is the hardest time to do that. In the Willamette, it wasn't so polarized. You have a bigger population base and livelihoods are fundamentally tied to one thing like the farmers. When talking about water in the Klamath, you were talking about a direct threat to their livelihood. In Willamette people were interested and knew it was important.

Question 7

Is there a way to include services from built capital vs. natural capital and consider the tradeoffs to get an overall portfolio of use that maximizes value? Who captures the wealth?

DR. POLASKY

- Speaking to the first part, on built capitol vs. natural capital: In principle, this is an economic framework so it does not matter what you call it (human, social, natural….); it all fits into the same framework.
- With climate change, there may be changes to sea level, storm risk etc…so you think about flood mitigation and storm protection – can do it through natural capital (protect wetland) or you can approach it with built capital (levees). One can think about each separately or one can think of the system as a whole. My preferred option is to think about the whole system, not just one part of it. Think about outcomes and whole set of ecosystem services involved.
- Another component is to think in terms of capital assets; not just flow of services now but the future? Are we getting to s sustainable area where future generations can exist? (Larry Goulder and Ken Arrow (Stanford) working on notion of inclusive wealth).

Question 8

Is this an exhaustive set? Is there a way to do comparisons so that we can looks at portfolio and make those decisions based on what would be best for now and for the future? Are there examples?

DR. POLASKY

- Though I hate to use it, the New York City example is one.
- I would rather think about bottom line and human well-being and whether that's better served by human or natural capital. There is no reason we cannot do this now. The focus is on ecosystem services now because there is a view that these things were left out before, so in a way it is a response to that, but what we want to think about is the social and ecological systems and how both contribute to human well-being and non-human well-being (intrinsic value).

Question 9

What are the underlying assumptions in valuation? For example: underlying science is accurate.

DR. POLASKY

- It is based off of individuals and the choices that they would make. Economists talk about utility functions - preference functions, where the choice is between A and B. If you have a complete ranking based on alternative of an individual then you can ask them about tradeoffs, i.e. are you willing to trade additional money for less water quality? Etc..
- But there are a lot of critics of the way economists do valuation. It is based upon its individual that they know what they want and they can rank alternatives. There are lots of critics….I shy away from it. I do not want to do the valuation for species. Some economists do these kinds of surveys. There are many critics of the particulars and survey methods. Many practical questions remain to be answered.
- I was talking about public good and value to society - How do you go from the individual to society as a whole? On what basis do you do that aggregation?
    - Pareto principle - You can judge socially if it is unanimous…Could winners compensate looser to make it equal?
    - Cost/Benefit analysis…you just aggregate it and sum it and look at the net. But the individuals with greater income get more votes, so is that the right way to do social policy?

Question 10

How much is decision theory and behavior theory playing into ecological economics?

DR. POLASKY

- Behavioral economics has been on the rise for a decade or more. It is not about idealized values, but about how people actually make decisions. Frankly, it has been slow getting into ecological economics. It is problematic; especially when you ask people things they do not have much experience with or do not know anything about. Has not come to grips with new learning coming out of physiologic and behavioral econ.

Question 11

How are models like InVEST and land use scenarios communicated to decision-makers?

DR. POLASKY

- One way is the "black box" approach, or you can get into gory detail of models, which is when you lose people. Opposite is to present with basic idea. If you capture people with the straight forward idea, they get it. Willamette experiment is a clear and easy way people understand. Once they are interested, then people get into the details of how you did it. If you can present compelling questions at the beginning then people are willing to dive into the detail secondarily and get into with you. Be explicit about the motivation and kinds of analysis one could get and the results one could use.

Question 12

There are many economic benefit models for parks and open space, how do they differ from an InVEST model? What are they showing decision-makers as a product?

DR. POLASKY

- Most of the studies that value open space are from what an economist would call a hedonic or property approach, i.e. if a property is near a park, how much does that increase value? Roughly 2/3 – 3/4 of studies are of that mold which is not about ecosystem services as much as it is about looking at how property owners and their property value changes. Not why it changes, just how it changes.

Question 13

What are some opportunities and low hanging fruit that you see to implement an ecosystem services approach?

PARTICIPANT

- There seems to be opportunity to move into making a close link between land and biodiversity with clean water provision for water districts. If we could get that across to decision-makers it would come across as better spending, etc…

PARTICIPANT

- We are seeing evolution with REDD and avoided deforestations. Programs are now addressing social and environmental benefits and safeguards.

PARTICIPANT

- Changing commodity price and structure – areas where opportunity costs are low but changing as a function of changing commodity price and structure. Places like Ecuador and Costa Rica and subsidies are examples of successes.
- Those programs might not need to be based on valuation, in the traditional sense. Valuation is expense and has inherent problems. You do not need it; there are models of auctions that work and may help to get this going. The commodity moves going on are piling up public money.

PARTICIPANT

- There is a big opportunity for supply chains. Many unexpected companies are seeing this and looking for ways to use it; for a lot of people, it is vague. Companies are doing life cycle analyses of products, i.e. Nissan did examined their supply chain with WRI and were astonished to realized that their product relied heavily on water. Dow and Coca Cola are doing the same. They are all starting to be very active which opens a huge arena and is just starting to be recognized.

DR. POLASKY

- A real opportunity to develop some quick rapid response tools as opposed to in depth surveys, i.e. develop the ability to denote the change in carbon and water quickly. As academics, we always want to get it right, but let us get it right now so county commissioners and companies can use it. It is a promising place, particularly when tied to the land and to water quality.
- We focus on value in dollars, but can we use certain flash points? Can we just tell people the impacts on water quality? What about the probability of floods? Do not have to weigh in on value but give them the other powerful options which are relevant for decision-makers too.

Seminar

3

Valuation of Ecosystem Services

Speaker

Dr. James Boyd

GORDON AND BETTY MOORE FOUNDATION

Economic Valuation, Ecosystem Services, and Conservation Strategy

by Dr. James Boyd, Resources for the Future

INTRODUCTION

We live in an economic age. Financial language and arguments permeate our social and household discourse. Success and failure are judged by economic measures like GDP, profits, and income. Today's youth are more financially literate than past generations, and books on economic topics regularly make it onto bestseller lists. It is therefore not surprising that the desire to think of nature in economic terms is no longer confined to economists. Politicians, the media, conservancies, environmental advocates, and companies now routinely seek monetary analysis of, and justifications for, environmental protection. Headlines like "The world's ecosystems are worth $33 trillion," "Bats are worth at least $3 billion a year," and "The state of Georgia's forests yield $37 billion in ecological benefits each year" are all examples of a monetary depiction of nature's contributions to our well-being.[1]

Should the conservation community embrace and invest in monetary descriptions of nature's value? Will the "pricing" of ecological resources and systems advance the conservation agenda, and if so, how? To answer these questions, this article describes the ways in which ecological values are calculated, applied, and interpreted. It also discusses the philosophical and strategic implications of ecological valuation.

Dollar-based ecosystem valuations are in part a communications strategy. Dollar valuations translate nature's complicated role in our well-being into a simple bottom-line message that speaks to people in understandable monetary terms. Ecological valuation is also a scientific, methodologically sophisticated approach to environmental analysis. Akin to financial analysis, valuation studies are often designed to enlighten and influence specific decisions by businesses, governments, and non-governmental organizations (NGOs). In both cases ecosystem valuation can be controversial and subject to misinterpretation.

Skepticism regarding the accuracy, influence, and appropriateness of ecological valuation is healthy. Deeper understanding of economic valuation's meaning, strengths, and weaknesses will allow the conservation community to more effectively harness economic arguments to conservation strategy. As will be argued, ecological valuation is no panacea and is only *a* strategy, not *the* strategy, to advance the conservation agenda in coming decades.

WHY WE SHOULD MONETIZE NATURE'S BENEFITS

It is useful to review the arguments in favor of economic valuation before turning to opposing viewpoints. The positive hypothesis begins with an observation made earlier, that economic language and measures are an increasingly common and effective way to communicate across society. Economic descriptions of nature harness this language in the service of conservation and allow conservation's message to reach a wider set of audiences. While people can differ over whether or not nature should be described in economic terms, the fact is, nature produces a range of goods and services that are economically valuable. Why not discuss and measure those values so that they can be more concretely appreciated?

A motivation for ecological valuation is that nature's economic value is hidden from view. Because ecosystem goods and services tend to be shared, public goods that are not bought and sold, we do not see their value through the lens of market transactions. We are accustomed to thinking of cars and hamburgers as being valuable because we pay a price for them. We do not buy and sell ecosystem services, however, which may lead us to underappreciate their value. This is disturbing to conservationists and economists alike. After all, just because something has no price, does not mean that it is not valuable. One motivation for ecological valuation is to fill in these "missing prices," so that nature's value is seen and appreciated on an equal footing with market commodities.

Valuation is a close adjunct to the ecosystem services movement in conservation science and advocacy. Popularized over the last decade, but with much deeper roots in natural resource management and environmental economics, the ecosystem services concept holds that

[1] Results reported in the popular press based on Costanza et al. (1997), Boyles et al. (2011), and Moore et al. (2011), respectively.

natural systems produce goods and services that contribute to social and economic well-being. For example, almost any natural landscape produces cleaner air and water, supports species that provide our food and material needs, protects us against floods, and provides open space for recreation and beauty for our aesthetic and psychological well-being. All of these biophysical goods and services have an economic value. When ecologists and other natural scientists coordinate with economists, together they are able to 1) describe the production of ecosystem goods and services in biophysical terms, and 2) translate that biophysical production into estimates of economic value.

If successful, ecosystem services valuation provides environmental advocates with hard economic numbers that, in theory, can be more influential than qualitative descriptions of nature's value or non-economic conservation measures like biodiversity scores.[2] In front of planning boards, for example, land developers can easily point to the dollar value of a new shopping center or residential development. But those lands in their natural state also have a dollar value that, if calculated, may strengthen the argument against development.

Dollar values are also influential in arguments over new environmental regulations. Opponents of tighter regulatory standards routinely deploy economic arguments relating to the regulation's costs to business or property owners. The environmental benefits of regulation, translated into dollar terms, can help counter these objections.[3] Private companies, accustomed as they are to quantitative financial analysis of investments and strategy, would be better able to make decisions based on the true costs and benefits of their ecological inputs and corporate footprints.

Ecological valuations could also be influential in the calculation of our national economic accounts, such as gross domestic product (GDP). GDP is an influential yardstick used to measure the health of our economy and the success of government policies. Unfortunately, it only measures market goods and services. GDP always rises when we burn more coal, take more fish from the sea, and develop more land. By ignoring ecological costs GDP gives us a distorted view of our economy's health. If ecological costs were also measured and debited, GDP would give us a much more accurate view of our economic well-being and improve accountability for environmental losses. For example, the more energy people in the United States consume, the higher the U.S. GDP, even though energy consumption can lead to a range of ecological and human health impacts, which currently go unmeasured in the calculation of GDP. Similarly, the more fish harvested from our oceans, the higher our GDP, even though those harvests may be reducing future fish populations and future GDP. Measures that account for these kinds of ecological costs and depletions would give a more accurate depiction of our economic well-being now and in the future.

In summary, there are several motivations for ecosystem services valuation. The first relates to the perceived power of economic arguments and numbers in social discourse. Dollars are a yardstick with which people are deeply familiar. Dollars, as an economic concept, also underscore nature's connection to human, utilitarian concerns, as opposed to more ethical or biocentric concerns. Dollars also convey the message with precision and simplicity. Arguably, precision and simplicity convey a deceptive sense of certainty (given the complexity of ecological and economic systems), but simplicity has an undeniable power in most social learning and decision-making contexts.

A second motivation is rooted in economic and political theories of governance. If the goal of our political system is to maximize social welfare, our policy machinery requires knowledge of the ways in which our laws, regulations, planning, and investments affect overall social welfare. Are ecosystems' contributions to our welfare being adequately and accurately reflected in this calculus? It is possible that our failure to depict ecological benefits in monetary terms biases social decisions toward economic activities that are antagonistic to ecological health and production. If so, greater commitment to ecosystem valuation could serve both the interests of conservation and society as a whole.

Finally, valuation should not just be thought of as a black box that produces a numerical value. Viewed as a process rather than an answer, valuation can play a particularly positive educational and strategic role (specific valuation methods are described in more detail below, under "Where Do Economic Value Estimates Come From?"). For example, valuation involves identifying multiple ecological changes, each with their own consequences for human welfare (e.g., water quality, aesthetic, species, and air-quality improvements). When stakeholders are brought into the process to identify and describe these ecological and economic changes, the end result is a clearer, more tangible sense of the ecological goods and services they might otherwise take for granted. At its best, valuation promotes deliberation among experts, stakeholders, and communities — deliberations that teach us about nature's diverse contributions to human welfare.

[2] For more detailed overviews of legal and regulatory applications of ecosystem services valuation, see Ruhl et al. (2007) and Scarlett and Boyd (2011).
[3] Analyses of air-quality regulations, for example, are often able to show huge monetary benefits arising from improved human health outcomes.

ARGUMENTS AGAINST ECONOMIC VALUATION

The value of valuation as a conservation strategy should be debated rather than assumed. A skeptic can point to a range of concerns regarding valuation. Valuation studies will consume time, money, and human resources that could otherwise be devoted to conservation itself. While economic analysis and monetary valuations may be influential across a range of decision contexts (as argued above), it is not always clear whether benefit-cost analysis leads to different and better social choices, or is only used after the fact to justify decisions driven by politics, opportunism, or non-economic rationales. Analysts tend to think that analysis matters, yet it can be argued that most political decisions are driven more by emotion, stories, and ethical values than by "cold, hard numbers."

Critics of valuation note that many of our most important social choices — including the definition of our basic liberties and rights, decisions to go to war, and definitions of fairness and justice — are not subjected to benefit-cost analysis (Vatn and Bromley 1994). Since conservation can be viewed as a fundamentally ethics-driven social issue, should it not lie outside the set of choices subjected to economic analysis? As experiments with ecological valuation proceed, their positive influence on conservation decisions should be evaluated, rather than assumed.

Philosophical critiques emphasize the difference between valuations derived from nature's utilitarian benefits (extrinsic values) and the value of nature for its own sake (intrinsic values) (Sagoff 1996). The ecosystem services paradigm, including ecosystem valuation, with its emphasis on nature's economic role, seeks to measure extrinsic values. Nature's intrinsic value is reflected in the common ethical belief — and motivational message associated with many conservation advocates — that nature should be protected for its own sake, whether or not it contributes to human well-being.

Ecological systems yield both kinds of values, but the utilitarian perspective concerns some observers, who worry that utilitarian motivations are not sufficiently protective of nature (Foster 1997). For example, it is argued that the economic valuation of natural resources encourages us to think of them as property that can be bought and sold, and thereby lost or destroyed should their loss or destruction be convenient (Macauley 2006). While that concern has merit, it is worth noting that intrinsic and extrinsic values in social policy are not necessarily mutually exclusive. In other words, we can and do value nature *both* for its utilitarian contributions to our more utilitarian needs (food, shelter, recreation, industry) and as a source of intrinsic spiritual, cultural, and biological value.[4]

Conservationists might also worry about what economic valuations will reveal about nature's value. What if valuations are "too small"? Could conservation objectives be thwarted if valuations show ecological benefits to be smaller than we imagine, expect, or hope? Here we should carefully distinguish between valuations that are small because they are incomplete (an issue we will address in detail under "Critical Interpretation of Ecological Valuations," below), and valuations that are small because people do not place great value on a given resource. It is possible that people will not place a high value on a given natural resource, even if they are fully informed. An unavoidable economic reality is that not all resources have equal value. As a rule, ecological resources in some landscape and social contexts will have relatively high values, while in other landscapes the same resources may have relatively low values.

Judging nature's importance via public preferences can also be worrisome if we believe that the average person is uninformed or irrational. Won't the preferences of average folks be "wrong" because they are not as enlightened as those of more educated and concerned stakeholders?[5] As a brief aside, this line of thinking deserves a critique of its own. First, it conveys an undemocratic and elitist attitude that may alienate potential conservation supporters. Second, it ignores valuation's ability to address people's ignorance. If people are ignorant of nature's benefits, one reason may be that not enough attention has been given to economic assessment. Valuation studies that give greater tangibility to nature's benefits increase the public's ecological literacy.

All that said, however, ignorance of ecosystems' role in our well-being is a serious issue for valuation methods. Consider how an average person values a car versus a wetland. Most of us will buy and sell several cars over our lifetime. The price of cars can be found in the newspaper, online, on TV, and at competing dealerships. Our media inundates us with advertisements that describe cars' features and qualities. When we buy a car, we spend time thinking about and trading off in our own minds the value of certain features versus their cost. All of this information and experience educates us.

[4] It is also important to debunk a common misconception about utilitarian values: that they refer only to profit-making or consumptive uses of nature. In fact, economists consider ecosystem benefits such as species protection, beauty, wildness, and cultural significance to be utilitarian values in need of, and consistent with the goals of, economic measurement.

[5] A related concern arises from psychological experiments that call into question people's ability to make value judgments about complicated and unfamiliar subjects. A representative study found that subjects based their preferences on *less* information, the more complex and unfamiliar the environmental decision presented to them (Gregory et al. 1993).

We are not experts in wetland valuation. We have never bought one, sold one, seen one advertised, or been able to look up a wetland price in the classifieds. Some of us have chosen to live, hike, or boat near one. But beyond that our individual wetland valuation expertise is extremely limited. The ecologically sophisticated among us may understand that wetlands improve water quality, shelter species, and protect us from floods. But that understanding tends to be qualitative rather than quantitative — in other words, we know that wetlands are valuable because they do those things, but it is hard for us to know *how* valuable they are.

This means that if we simply ask people to "value a wetland," we should not expect economically accurate answers. Stakeholders can explain how, why, and in what ways the wetland is important to them, thereby providing useful information to help economists arrive at a more accurate answer. This also means that natural scientists must be involved in the valuation exercise. Ecologists and other natural scientists are needed to quantitatively understand the relationship between wetlands and the goods and services (cleaner water, reduced flood risks, more abundant fish and bird populations) delivered by them. The value of wetlands cannot be calculated without the knowledge of ecological production and local uses.

As a general rule, valuations will be more enlightened the closer the good or service in question is to our daily experiences and choices. The values of species we hunt, harvest, or seek out for aesthetic enjoyment are easier for us to value than species we are unaware of or rarely see. That does not mean that unseen species are not valuable — to the contrary, they are often necessary (e.g., as part of food webs) to the existence of species we do value, and therefore are valuable themselves. But the overwhelming majority of people are understandably unable to perceive or quantify that value.

PRICES VS. VALUE VS. IMPORTANCE

How do economists define the value of nature? Assigning a value to something is simply a way to depict its importance or desirability. Economic values can be thought of as rankings, weights, or priorities. Values are detected or measured by examining people's choices. Whenever we choose one thing over another, as individuals do every day, we are engaged in valuation.

One common way to measure values is via prices. Market goods and services have easily observable prices that are an important clue to their value. After all, if we pay $100 for something, that means the good must be worth at least $100. Note, though, that the actual value to us of the goods we buy is almost always higher than the price we pay. The difference between what is paid and what we would be willing to pay — given the value of the product to us — is the "benefit" of the purchase. Economists refer to this benefit as consumer surplus. The thing to keep in mind is that a thing's price is not the same thing as its economic value.

Prices are used as measures of value for a simple reason: they are easy to observe and yield a reasonable reflection of social preferences for goods. The price of cars is higher than the price of bicycles, which accurately reflects the fact that most people value cars more than bicycles.

It is also important to understand that economic valuation methods mostly help us understand the value of having a bit more or a bit less of something. In contrast, economic valuations of the aggregate importance of a resource or ecological system — the value of a lot more or a lot less — are inherently more dubious (Heal 2000). This causes a great deal of understandable confusion when economists and environmentalists discuss the value of nature. It is natural to think of the value of nature as referring to nature's larger importance — e.g., the value of the world's freshwater or forests or ecosystems. Many in the environmental community are concerned about major ecological losses (to species, water, natural lands), and want to know the value lost if there were to be a significant collapse in ecological quantity or quality. Most economists would argue that the lost value of large ecological degradations is likely to be real and large. Unfortunately, the tools and data at our disposal to measure the value of major ecological changes with precision are limited.

Supply and demand conditions determine prices, rather than the aggregate importance of the good. To see this, consider what is known as the diamonds and water paradox (attributed to Adam Smith). Water is necessary to life and is therefore much more economically and socially important than diamonds. So why is the price of diamonds so much higher? The answer is that diamonds are scarce relative to demand, whereas water is usually abundant relative to demand. Prices tell us about the value of water and diamonds "at the margin," where we get a little bit more or little bit less of them. But clearly those prices give us a misleading sense of the value we would lose if we lost *a lot* of water. The importance, or value, of the entire world's freshwater is nearly infinite, since without water all other economic and social welfare would be threatened.

In summary, economists are comfortable saying the following: 1) the total value of ecological resources and systems may be very large, if not nearly infinite, and 2) the marginal value of ecosystem goods and services — the value of having a little bit more or a little bit less of

them — will rise as they become scarcer. Unfortunately, all we can observe through market prices or other choice behaviors are marginal values given current supply and demand conditions. Thus our ability to measure total (non-marginal) values, or importance, is limited.

Consequently, there is a potentially frustrating disconnect between the kind of economic valuations that many in the conservation community desire for purposes of communication and motivation and what mainstream economists are intellectually comfortable delivering. Consider the widely disseminated and influential study that placed a US $33 trillion value on the world's ecosystems (Costanza et al. 1997). The study was influential and beneficial for several reasons: it generated a huge economic number, reached a wide variety of audiences, prompted extensive academic and policy discussion, and attempted to do something almost heroic — value the world's ecosystems.

Within mainstream economics, however, such valuations are viewed as wildly inaccurate "results" derived from assumptions that violate fundamental economic principles. The Costanza et al. study in particular prompted widespread consternation within the environmental economics community (Bockstael et al. 2000). Interestingly, most of the consternation was not that the US $33 trillion estimate was too large — in fact, one economist observed that US $33 trillion was a "serious underestimate of infinity," given that society would pay everything it had to avoid the loss of the world's life support system (Toman 1998). Instead the discomfort was due to the fact that the economic value of large gains or losses in ecosystems is simply unknowable.

As noted earlier, economists can only measure the value of marginal ecosystem changes given current supply and demand conditions. Moreover, the value of massive gains or losses in ecosystems cannot be extrapolated from these existing marginal values, because marginal values change as the scale of the gain or loss changes (the point of the diamonds and water thought experiment). The US $33 trillion figure was derived by multiplying existing marginal value estimates by the total area or amount of the world's ecosystems, a practice that violates the fundamental economic axiom that marginal values change as the supply of or demand for a good changes.

Should the conservation movement worry about these academic disagreements? No, if the point of economic valuations is to capture the public's imagination and convey the notion that nature's value can be described in monetary terms. Yes, if economic valuation is to produce results that weather the scrutiny of academic economists.

WHERE DO ECONOMIC VALUE ESTIMATES COME FROM?

The economic approach to valuation relies on observation of individual, household, and community choices. Choices are a particularly reliable form of evidence when it comes to detecting preferences and values. When we make choices, we reveal our preferences for one thing over another. Paying for something is a choice. When we pay for something we are deliberately choosing it over the amount of money we paid. Assuming that people are rational, they will only pay the price if the thing they are buying is worth at least that much to them. The higher the price that is paid, the higher the valuation we can infer.

Prices are desirable not because they are the ideal measure of value, but because they are readily available. We can use market prices to value some ecosystem goods and services, but only those that are bought and sold as private goods. Examples of ecosystem goods that are bought and sold in private markets include timber, commercial fish harvests, and carbon sequestration credits (if a credit market exists). Often, however, ecosystem goods and services are public, non-market commodities for which there is no market price. Without market prices, economists must resort to so-called non-market valuation methods described below.

Non-Market Valuation Methods

HEDONIC VALUATION METHODS

Hedonic valuation methods examine the prices people pay for things that have an environmental component. For example, when people purchase a home near an aesthetically pleasing ecosystem, home prices reflect that environmental amenity.[6] The price premium of living near the ocean, having a mountain view, or being in close proximity to urban parks can be measured via statistical analysis. Similarly, farm values are related to the availability of groundwater, precipitation, and soil quality. The premium due to those features can be estimated by controlling for other factors that affect farm value.

[6] For an example, see Mahan et al. (2000).

Evidence of conservation value can also be inferred from political choices such as prohibitions on drilling, development, and other land-use changes associated with public lands, or conservation referenda that approve local or state financing of land acquisitions (Banzhaf et al. 2010).

TRAVEL COST METHODS

Travel cost methods examine the costs people are willing to bear in order to enjoy natural resources. When we spend time and money in order to enjoy nature, we are revealing something about its value. Again, if we are willing to pay the price (the cost), we must value the experience, enjoyment, or use of the resource more than the cost.[7] The travel cost method requires data and analysis linking the number of trips to a site to its quality, size, or location. Changes in these attributes can be valued if there is a perceptible change in the number, length, or cost of trips taken to the site.

Another technique is to examine costs avoided by the presence of an ecological feature or service. For example, if we lose wetlands and their water purification and flood damage reduction benefits, we may have to invest in water treatment facilities, levees, and dams. If instead we protect the wetlands, we avoid the costs associated with built infrastructure alternatives. Similarly, private firms can conduct engineering and economic analyses that calculate the costs associated with, for example, the loss of surface waters for cooling, where the cost might be associated with new refrigeration technologies.

STATED PREFERENCE METHODS

Another approach, called the stated preference method, is to present people with hypothetical scenarios that ask them to choose, in a survey format, between an ecosystem good or service and something with a clear dollar value, such as an increase in property tax. To pass academic muster, these studies are much more structured and carefully designed than simple opinion polling (Kopp et al. 1997). Stated preference methods are controversial because people's choices are undisciplined by the need to spend their own, real money, which in principle may lead them to overstate their willingness to pay. Care must also be given to clearly defining and isolating the good or service in question and framing the choice problem in a way that does not bias the responses. Nevertheless, stated methods are an improvement relative to evaluation techniques that ignore social preferences (Carson et al. 2001).

BENEFIT TRANSFER METHODS

Finally, mention should be made of benefit transfer methods, which take existing valuations derived from any of the aforementioned methods and transfer them to new landscape and resource contexts. Benefit transfer studies are desirable because they avoid the costs of conducting original valuation research. However, the transfer of valuations from one ecological and social context to another is dangerous, because ecosystem values are highly dependent on location (addressed in more detail under "Critical Interpretation of Ecological Valuations," below. Benefit transfer involves statistical methods designed to control for similarities and differences in spatial context and adjust the transferred valuation accordingly.

Researchers have assigned economic values to a wide range of ecosystem goods and services in specific spatial and social contexts. A review of existing valuation studies is beyond the scope of this paper (see Boyd and Krupnick 2009 for a review, and the Environmental Valuation Reference Inventory database of available studies). In general, the non-market valuation methods described above have a long history and are considered within economics to be a valid, if imperfect, approach to the problem of missing prices associated with public environmental goods (Freeman 1993). As a rule, the academic valuation literature finds clear evidence that ecological systems and the goods and services they produce are indeed economically valuable.

CRITICAL INTERPRETATION OF ECOLOGICAL VALUATIONS

The section titled "Arguments Against Economic Valuation" described a set of philosophical critiques of valuation as a tool to positively influence conservation outcomes. "Prices vs. Value vs. Performance" added a caution relating to the inherent difficulty of deriving credible economic values for large ecological changes or the "importance of nature." To improve the conservation community's sophistication as users and interpreters of valuation studies, several additional issues are worth noting.

[7] For an example, see McConnell (1992).

Most Valuation Results are Incomplete.

Most published valuations of ecosystem goods and services are incomplete measures of the resource's value. In general, this is obvious to the economists conducting the study, and is often explicitly acknowledged in the study. It may not always be obvious to the non-economic reader or consumer of the study, however.

Valuation studies often detect the value of ecological resources to neighboring households or businesses (via hedonic analysis) or recreators who travel to the site (via travel cost methods). But such studies usually do not and cannot measure the full ecosystem service benefits associated with the resource.

Consider a concrete example, cited earlier (Mahan et al. 2000), that used the hedonic valuation technique to measure the value of wetlands to a neighboring community in Portland, Oregon. The study found that larger wetlands increased property values, as did proximity to wetlands. Specifically, reducing the distance to the nearest wetland by 1,000 feet increased property values on average by US $436. But this result is a decidedly incomplete measure of the wetlands' value, as the authors take care to acknowledge. It is instructive to reflect on why that is true. The hedonic analysis *only* captures the wetland's benefits to neighboring property owners — their value as aesthetically appealing open space, for example. The analysis does not capture the aesthetic value enjoyed by commuters, visitors, or other transient beneficiaries.

More important, local property values do not capture the wetlands' role in larger habitat and hydrologic systems. For example, the wetlands may slow flood pulses (reducing flood damage), clean and replenish groundwater (reducing treatment costs and health risks), lead to greater surface water quality (improving recreational experiences and supporting aquatic species), and provide habitat for migratory species such as birds. Some of these benefits may accrue to local property owners, but not all. To the extent the wetland benefits systems and beneficiaries further afield, benefits based on local property price premiums will understate benefits.
As a general rule, valuation studies have only the time and resources to measure one particular benefit of a resource or ecosystem (e.g., the benefits of open space or surface water quality enhancement) enjoyed by one set of beneficiaries (e.g., neighboring households or tourists). This is true because, typically, different ecosystem benefits and beneficiaries must be analyzed with different data and econometric methods. In principle, the full range of ecosystem benefits can be measured, including "off-site" benefits that arise due to a resource's productivity across a watershed, aquifer system, habitat mosaic, or air shed. However, in practice this is rare, in part due to the cost and difficulty of economic study, and in part to the cost and difficulty of biophysical analyses that track systems of biophysical production across larger landscapes.

If an ecological valuation appears to be low, one reason may be that the valuation is capturing only a subset of the resource's benefits — a point that should be kept in mind when conservation organizations use academic valuation studies for communication and planning purposes.

Ecological Values Depend on the Resource's Location.

A second valuation issue worth noting is that the value of most ecosystem goods and services is highly dependent on their location (and sometimes the timing of their delivery). The dependence of value on location complicates the interpretation and extrapolation of one valuation study to other locations and decision contexts. Usually an ecosystem service value detected by one study in one place cannot simply be transferred to another place.

Spatial analysis — and interpretation — is fundamental to ecosystem service valuation because both the biophysical production of goods and services and the social determinants of their benefits depend upon the landscape context (Bockstael 1996; Polasky et al. 2008). From an ecological perspective, geographic context matters for several broad reasons. First, ecological production can exhibit scale and connectivity effects — for example, where a whole produces much more than the sum of unconnected parts. Second, natural systems are often characterized by movement: air circulates, water runs downhill, species migrate, seeds and pollen disperse. Moreover, the movement of one biophysical feature (e.g., water) tends to trigger the movement of other things, like birds and fish. As noted above, the consumption of ecosystem services often occurs off-site. Water purification, flood damage reduction, pollination, pest control, and aesthetic enjoyment are all services typically enjoyed in a larger area surrounding the site in question.

Spatial context matters for another reason as well, this one related to the economic value of a given ecosystem service. As economic commodities, ecosystem goods and services resemble real estate rather than cars or bottles of dish soap. The value of real estate is highly dependent on its location — the features of the surrounding neighborhood — because a given house or building cannot be easily transported to another neighborhood. In contrast, cars or soap can easily be moved around (shipped from one location to another), so

their value tends to be independent of their geographic location.

The value of irrigation and drinking water quality depends on how many people depend on the water, which is a function of where they are in relation to the water. Flood damage avoidance services are more valuable the larger the value of the lives, homes, and businesses that are protected from flooding. Species important to recreation (for anglers, hunters, birders) are more valuable when more people can enjoy them.

Values Depend on the Presence of Other Goods and Services.

Placing a value on ecosystem goods and services also requires us to analyze the presence of substitutes for the good. The value of any good or service is higher the scarcer it is. How do you measure the scarcity of an ecosystem good? If recreation is the source of benefits, substitutes depend on travel times. The value of irrigation water depends on the availability (and hence location) of alternative water sources. If wetlands are plentiful in an area, then a given wetland may be less valuable as a source of flood pulse attenuation than it might be in a region in which it is the only such resource. In all of these cases, geography is necessary to evaluate the scarcity and presence of substitutes.

Finally, many ecosystem goods and services are valuable only if they are bundled with certain manmade assets. These assets are called "complements" because they complement the value of the ecosystem service. Recreational fishing and kayaking require docks or other forms of access. For example, a beautiful vista yields social value when people have access to it. Access may require infrastructure — roads, trails, parks, housing — all of which are spatially configured.

Accordingly, in order to judge the relevance of a particular valuation study to a new context, it is necessary to know how socially and biophysically comparable the original and new locations are. Environmental economics has developed a set of methods to "transfer" or adjust results as locations change — so-called benefit transfer methods (Kirchoff et al. 1997).

Valuations Will Change Over Time.

A final valuation issue is that ecological valuations are likely to change over time, perhaps substantially. The date of valuations from the published literature, some of which go back decades, should be kept in mind. Supply and demand conditions almost certainly will dramatically change in parts of the world, due to climatic and demographic factors. Less supply and more demand (e.g., for freshwater) will lead to higher valuations than are currently detected.

Also, our knowledge of ecological phenomena is undergoing rapid change.[8] With greater social knowledge will come a change in perceptions of nature's role in social well-being and economic activity. For those of us in middle and old age, it is worth recalling the vast changes in environmental attitudes seen across our own lifetimes (people used to litter!). And as countries and households in the developing world become richer, their demand for ecological protection is likely to change. While greater wealth may place even greater stresses on ecological systems, it is also possible that rising incomes will lead to relatively greater demand for environmental protection (McConnell 1997).

Valuations derived decades ago need not reflect current social preferences, nor will current valuations necessarily predict preferences in several decades' time. Conservationists are often concerned with ecological threats and losses on a decadal timescale. It is worth repeating that contemporary valuation estimates only tell us about current preferences, based on current supply and demand conditions. We can expect that supply and demand conditions will change over time (leading to different, virtual, non-market ecological prices), and that society's underlying preferences themselves may change as knowledge and incomes change.

COMMUNICATING AND QUANTIFYING NATURE'S ECONOMIC BENEFITS WITHOUT DOLLARS

This review has focused on studies, results, and methods designed to put a dollar value on ecosystems for the component goods and services they produce. Dollar-based valuations can be a clear and powerful way to convey the message that nature is valuable, and to influence decisions and discourse. However, monetary estimates of nature's benefits based on sophisticated statistical techniques rooted

[8] The fact that we inadequately understand ecological systems triggers another valuation issue for economists: the value of improved ecological information. When we act in the presence of uncertainty, mistakes are made. Knowledge that helps us avoid costly mistakes has value. For a discussion of the value of improved ecological information, see Boyd (2010).

in economic theory are not necessarily the only way to quantify and communicate the connection between conservation and economic well-being.

An argument made throughout this paper is that valuation can be thought of as a process by which decision-makers and communities learn about nature's role in our lives. Academically sophisticated valuation methods can foster this learning but can also inhibit it. Monetary assessments of conservation benefits often rely on opaque statistical procedures and involve unstated or unclear assumptions. As noted earlier, they also may capture only a fraction of the ecosystem's benefits, and they communicate via a fairly abstract, oversimplified outcome measure, dollars.

There is an alternative approach to economic quantification: ecosystem benefit indicator (EBI) analysis can be applied to ecosystem conservation and management decisions. EBIs are measurable features of the physical and social landscape that relate to and describe the value of ecosystem goods and services (Boyd and Wainger 2002, 2003). Example indicators include:

- The number of farms that would benefit from an increase in summer water flows as a result of conservation that improves retention of upstream precipitation
- The number and/or value of buildings, farms, and roads in floodplains protected by wetland protection and restoration
- The number of recreators who will benefit from increased open space and species populations

Other economically relevant, and measurable, indicators include:

- The scarcity, at the scale of the neighborhood, watershed, region, wetlands, open space, habitat, or other ecological features (in general, the scarcer the feature, the more valuable)
- The presence of ecological or social features that complement the resource, such as streams or lakes that add to the experience of forest recreation or trails and docks that provide access to natural resources for recreators

All of these indicators, and others like them, are relatively easy to measure using existing social and environmental datasets, geo-referenced data in particular (such as census and land-cover data).

Arguably, EBIs can help conservationists tell the "ecosystem service story" more clearly and comprehensively than a strategy that focuses on dollar valuation alone. EBIs are quantitative, so they provide audiences with real, verifiable facts. They also permit an intuitive appreciation of economic principles (such as the importance of scarcity to value) that may otherwise be obscured by jargon or complicated statistical models.

Ecosystem Benefit Indicator Example

Consider the following entirely hypothetical comparisons of two wetlands, one based on a monetary valuation study, another on an EBI evaluation. Services provided by the two wetlands could be analyzed by economists and monetary valuations derived, leading to the result that:

- Wetland A's ecosystem services are worth US $723, 000
- Wetland B's ecosystem services are worth US $537, 000

Alternatively, an EBI analysis could compare the two wetlands in the following way.

WETLAND A:

- Is visible from 712 acres occupied or used by homeowners, businesses, commuters, and recreators
- Protects 23 drinking water wells from saltwater intrusion
- Protects US $5 million in private and public property from flood damage

WETLAND B:

- Is visible from 600 acres occupied or used by homeowners, businesses, commuters, and recreators
- Protects 67 drinking water wells from saltwater intrusion
- Protects US $3 million in private and public property from flood damage

Assume that all the facts present in the EBI result were factored into the dollar valuation. Now compare these two study results purely as forms of communication. It is possible that for some decision-makers and stakeholders, the EBI approach will be perceived as less philosophically offensive (because it avoids a description of ecological value in monetary terms), more enlightening (because it more intuitively conveys the connection between ecology and human concerns), and more useful to conflict resolution and consensus (because it clarifies rather than obscures tradeoffs).[9]

The disadvantage of the EBI approach is that is does not directly answer the question: Which wetland is more valuable? Rather, it presents information that allows stakeholders to learn, deliberate, and adjust preferences in order to arrive at their own preference ranking. In contrast, a conventional monetary valuation study would attempt to measure those preferences more directly by observing previous behavior and choices.

The comparison between monetary valuation methods and EBI evaluation is in no way meant to suggest that one is better than the other; in fact, the two methods are complementary. But sophisticated monetary valuations tend to get the lion's share of attention when we think of economic assessment of ecosystem services. This is unfortunate, not only because EBIs are potentially a valuable way to provide useful economic information and communicate ecosystem service benefits, but also because they allow more comprehensive evaluations of multiple goods and services, given limited budgets for analysis. An EBI approach to assessment of ecosystem services benefits may be well-suited to conservation strategy, particularly when a conservancy's goals include stakeholder learning, communication, and conflict resolution.

CONCLUSIONS

The economic value of ecosystem goods and services is real, often large, and relevant to a wide range of decision-makers and stakeholders. Economic arguments, language, and outcomes are already helping the conservation movement influence decisions and recruit a wider set of partners. Economic arguments are not a substitute for biophysical and ethical arguments in favor of conservation. Rather, they complement other conservation motivations by enriching the description of nature's role in our personal and community well-being. Economic valuation's role as a mode of communication and a guide to conservation policy and planning will — and should — continue to grow.

But as surely as economic arguments will be used to make the case, so too will they generate skepticism, if not outright opposition. It is incorrect to associate economic analysis with selfish, profit-driven motives or private ownership of otherwise public resources. To be sure, economic analysis can and does concern itself with nature's role in markets, profit maximization, and property ownership. But it is in no way confined to those spheres. The value of beauty, cultural significance, and stewardship of species other than our own can also be expressed and measured economically.

A more legitimate question to raise about economic valuation is the degree to which it actually works for conservation as a communications and motivational tool. It may be that ethical and emotional arguments in favor of conservation dwarf economics' more rational, utilitarian arguments. On the other hand, there is ample evidence that economic arguments for conservation are in demand — by government, community, corporate, and NGO decision-makers. It is also clear that monetary estimates of the value of ecosystem services could immediately be applied within decision frameworks that already measure outcomes in economic terms (e.g., regulatory impact analyses, national economic accounts, natural resource damage assessments, and environmental markets).[10]

By providing an overview of valuation methods — including a review of common assumptions — this article attempts to empower conservation leaders with a more sophisticated understanding of valuation's strengths and weaknesses. Valuation results usually require careful interpretation in order to clearly understand what is being valued and what is not, how current values relate to future values, and whether or not values can be transferred to other conservation contexts. Informed consumers of valuation studies will be able to use their results — and counter objections — more effectively.

Finally, ecosystem valuation should be thought of not just as a technique to generate dollar-based arguments in favor of conservation. Economics can help conservationists tell stories that convey the connections between nature conservation and social well-being. Economic analysis of ecosystem services may yield the greatest strategic benefit to conservation if it is pursued as a process designed to educate, communicate, and deliberate, rather than as a way to simply monetize nature's value.

[9] The tradeoff comes from the fact that Wetland B provides more well water protection, whereas Wetland A provides more aesthetic and flood protection services.
[10] See Scarlett and Boyd (2011) for a review of decision frameworks amenable to or already employing ecosystem service valuations.

REFERENCES

Banzhaf, H. Spencer, W. Oates, J. Sanchirico 2010. Success and design of local referenda for land conservation. *Journal of Policy Analysis and Management* 29(4):769–798.

Bockstael, N. 1996. Modeling economics and ecology: The importance of a spatial perspective. *American Journal of Agricultural Economics* 78:1168–1180.

Bockstael, N., A. M. Freeman, R. Kopp, P. Portney, and V. K. Smith. 2000. On measuring economic values for nature. *Environmental Science and Technology* 34(8):1384–1389.

Boyd, J. 2010. *Ecosystems and climate adaptation.* Issue Brief 10-16. Washington, DC: Resources for the Future.

Boyd, J., and A. Krupnick. 2009. *The definition and choice of environmental commodities for nonmarket valuation*. DP-09-35. Washington, DC: Resources for the Future.

Boyd, J., and L. Wainger 2003. *Measuring ecosystem service benefits: The use of landscape analysis to evaluate environmental trades and compensation.* DP-09-35. Washington, DC: Resources for the Future..

Boyd, J., and L. Wainger 2002. Landscape indicators of ecosystem service benefits. *American Journal of Agricultural Economics* 84(5):1371–1378.

Boyles, J., P. Cryan, G. McCracken, and T. Kunz 2011. Economic importance of bats in agriculture. *Science* 331 (6025):41–42.

Carson, R., N. Flores, and N. Meade. 2001. Contingent valuation: Controversies and evidence. *Environmental and Resource Economics* 19:173–210.

Costanza, R., R. D'Arge, R. DeGroot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. O'Neill, J. Paruelo, R. Raskin, Paul S., and M. Van Den Belt 1997. The value of the world's ecosystem services and natural capital. *Nature* 387:253–260.

Foster, J. 1997. *Valuing nature: Economics, ethics and environment*. New York: Routledge.

Freeman, A. M. 1993. *The measurement of environmental and resource values: Theory and methods.* Washington DC: Resources for the Future.

Gregory, R., S. Lichtenstein, and P. Slovic 1993. Valuing environmental resources: A constructive approach. *Journal of Risk and Uncertainty* 7:177–197.

Heal, G. 2000. Valuing ecosystem services. *Ecosystems* 3(1):24–30.

Kirchhoff, S., B. Colby, and T. LaFrance. 1997. Evaluating the performance of benefit transfer: An empirical inquiry. *Journal of Environmental Economics and Management* 35:75–93.

Kopp, R. J., W. Pommerehne, and N. Schwarz, eds. 1997. *Determining the value of non-marketed goods: Economic, psychological, and policy relevant aspects of contingent valuation methods.* Boston, MA: Kluwer Academic Publishers.

Macauley, D. 2006. Selling out on nature. *Nature* 443:27–28.

Mahan, B., S. Polasky, and R. Adams. 2000. Valuing urban wetlands: A property price approach. *Land Economics* 76(): 100–113.

McConnell, K. 1992. On-site time in the demand for recreation. *American Journal of Agricultural Economics* 74:918–925.

McConnell, K. 1997. Income and the demand for environmental quality. *Environment and Development Economics* 2:383–399.

Moore, R., T. Williams, E. Rodriguez, and J. Hepinstall-Cymmerman. 2011. *Quantifying the value of non-timber ecosystem services from Georgia's private forests.* Athens, GA: Warnell School of Forestry and Natural Resources, University of Georgia.

Polasky, S., E. Nelson, J. Camm, B. Csuti, P. Fackler, E. Lonsdorff, C. Montgomery, D. White, J. Arthur, B. Garber-Yonts, R. Haight, J. Kagan, A. Starfield, and C. Tobalske. 2008. Where to put things? Spatial land management to sustain biodiversity and economic returns. *Biological Conservation* 141:1505–1524.

Ruhl, J. B., S. Kraft, and C. Lant. 2007. *The law and policy of ecosystem services*. Washington, DC: Island Press.

Sagoff, M. 1996. On the value of endangered and other species. *Environmental Management* 20(6):897–911.

Scarlett, L., and J. Boyd. 2011. *Ecosystem services: Quantification, policy applications, and current federal capabilities*. DP-11-13. Washington, DC: Resources for the Future.

Shabman, L., and K. Stephenson 2000. Environmental valuation and its economic critics. *Journal of Water Resources Planning and Management* 126(6):382–388.

Toman, M. 1998. Why not to calculate the value of the world's ecosystem services and natural capital. *Ecological Economics* 25:57–60.

Vatn, A., and D. Bromley 1994. Choices without prices without apologies. *Journal of Environmental Economics and Management* 26:129–148.

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Seminar

3

Valuation of Ecosystem Services

Speaker

Dr. James Boyd

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GORDON AND BETTY MOORE FOUNDATION

Ecosystem Services Seminar 3: Valuation of Ecosystem Services

Presentation and Discussion Notes From Speaker: Dr. James Boyd

Seminar Series and Seminar 3 Goals:

The goal of the multi-session seminar is to educate the broader conservation community including practitioners and funders on the diverse aspects of ecosystem services – such as how to account for ecosystem services and to effectively measure, manage, and communicate them.

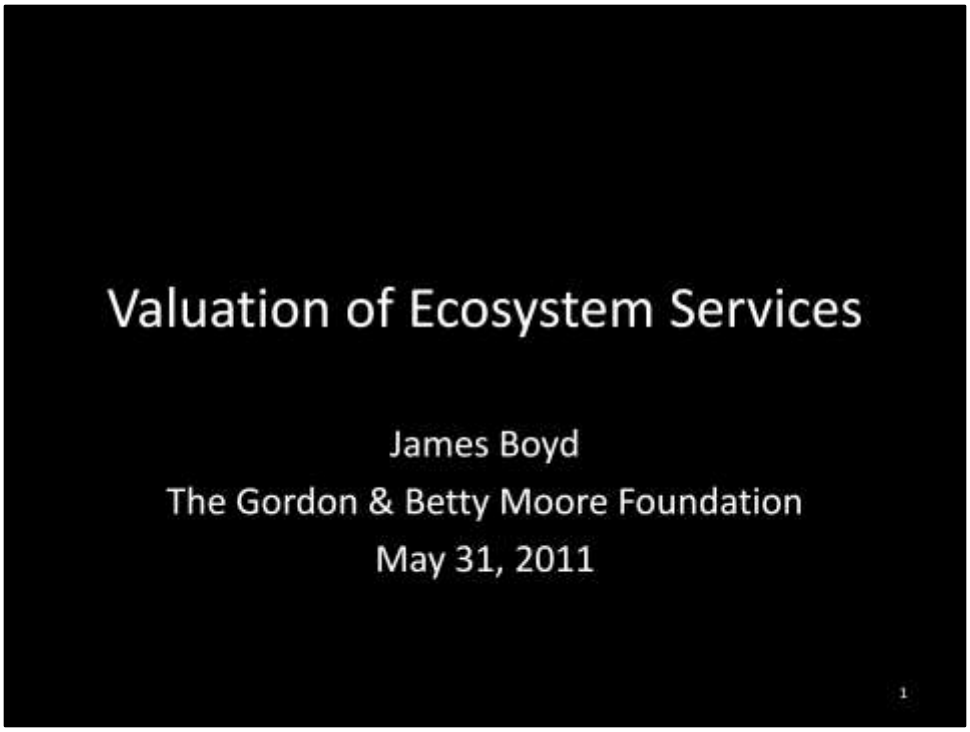
Seminar 3 and associated readings focused on the following goals:

- *Monetary and non-monetary valuation*
- *Methodologies for valuing ecosystem services: biophysical, economic, social*
- *Strengths and weaknesses of current methodologies*
- *Contrasting perspectives on "putting a price" on nature*
- *Tradeoff Analysis – how to make informed ecosystem services decisions regarding tradeoffs inherent in decision-making*

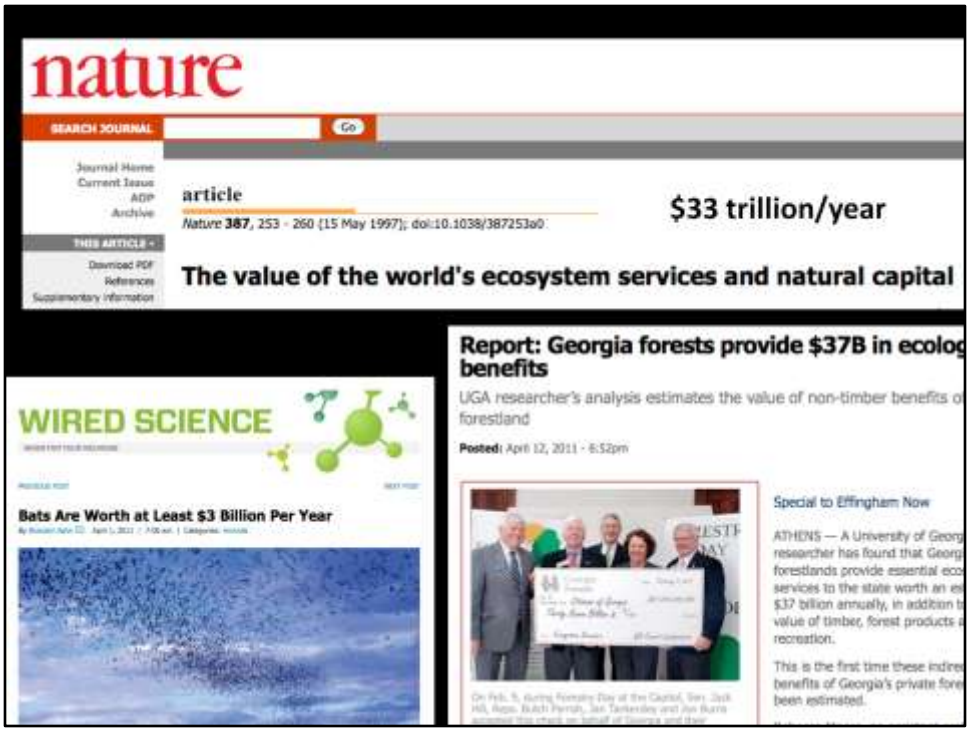
Disclaimer:

This document is a summary that includes PowerPoint slides from the speaker, Dr. James Boyd, and notes of his talking points. In addition, we provide a synthesis of important questions discussed during Seminar 3. Please keep in the mind that the following document is only a recap of Dr. Boyd's presentation and Blue Earth Consultants' notetakers have, to the best of their ability, captured the speaker's presentation. We hope that the following presentation and discussion notes will be used as resource to advance further discussions about ecosystem services.

GORDON AND BETTY MOORE FOUNDATION
COASTAL QUEST
BLUE EARTH CONSULTANTS



- This topic has a lot of room for philosophical discussion and the hope is that this presentation stimulates such discussion with an end focus on opportunities of ecosystem service valuation.



- I have been an economist for a few decades and the idea of thinking about nature and its value has become more common within the past five years.
- As a group, let us reflect on what is going on here.
  - Take the headline depicted on the slide that estimates the value of bats at $3 billion/year:
    - Do we believe that?
    - How will we use this kind of information?
  - I want to convey that valuation is happening and we need to figure out how to use it.

Tallying BP spill toll on wildlife, habitat

'Putting a price on a brown pelican is like trying to put a price on a sunset'

Fight for survival: An oiled crab crawls on the hand of P.J. Hahn, Plaquemines Parish coastal zone director

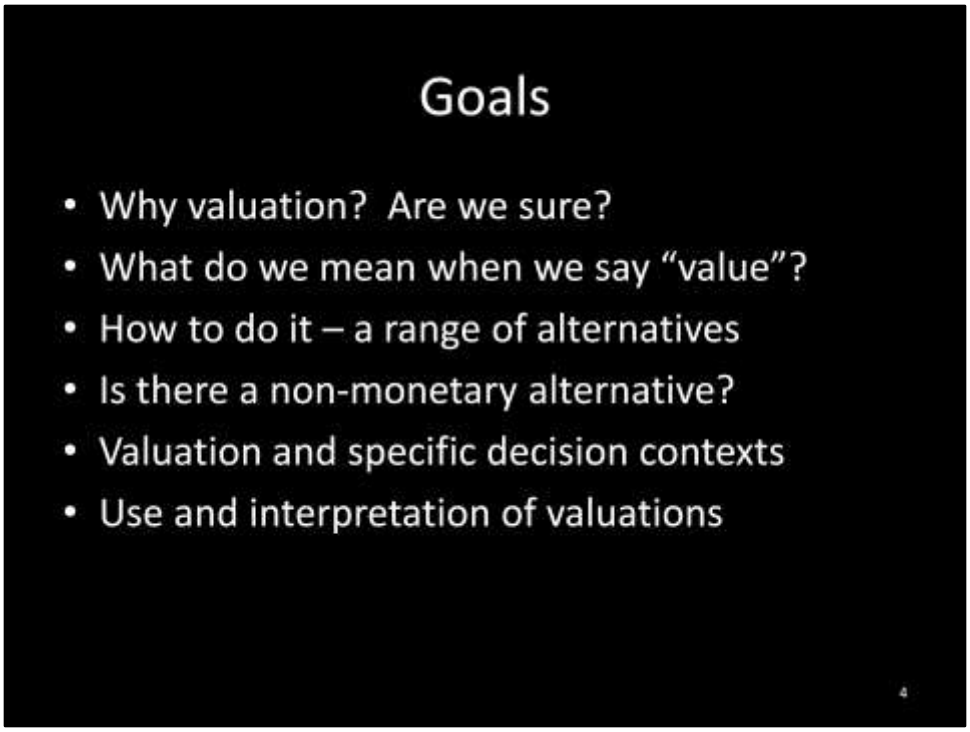
By Donna Leinwand
USA TODAY

What's a brown pelican worth?

"$328.63," deadpan economist Jim Boyd, senior fellow at Resources for the Future, a non-partisan economic research organization. "Reasonable people will differ on the value of a pelican. Some will say zero; some will say thousands."

It's a question that could consume environmental economists and scientists for years as they try to put price tags on the animals killed and habitat destroyed by the massive Gulf of Mexico oil spill — an environmental analysis federal officials describe as the largest of its kind. The federal and state authorities ultimately will send their bill to BP and the other compa-

- This article appeared in USA Today just after the oil spill in the Gulf of Mexico. A reporter called me to ask about the value of the brown pelican. I jokingly said $328.63 and proceeded to have an in-depth conversation with the reporter for another hour about valuation. The report only included the silly value I gave.
- The point of this story is to demonstrate the power of the number. It is what the media wants because that is what people understand, but they do not necessarily make sense. When you see them reported in headlines or in the media, be skeptical.



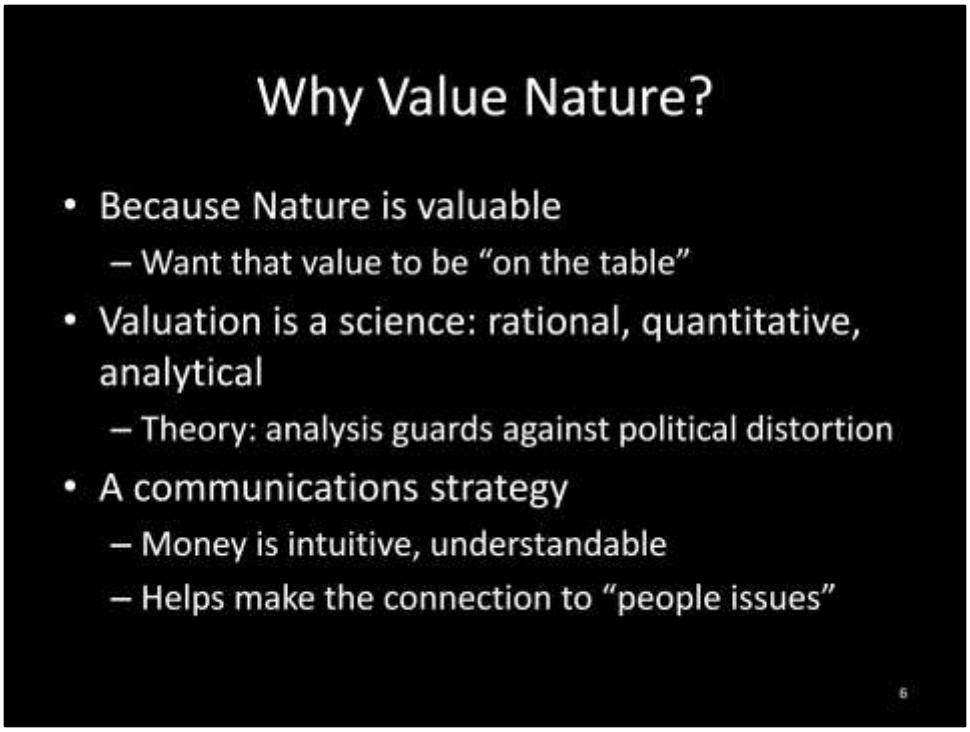
Presentation Goals

- I would like to be a little philosophical in today's presentation and think on how valuation is going to work in the long-run.
- This presentation will not be too technical, but I will briefly touch on technical aspects.
- Non-monetary alternatives are important. Non-monetary values can help to make the connection without resorting to the single dollar value at the end.
- We will also talk about opportunities to impact policy and public dialogues.

- Does anyone want to talk about why you think we need these values?

Group Responses:

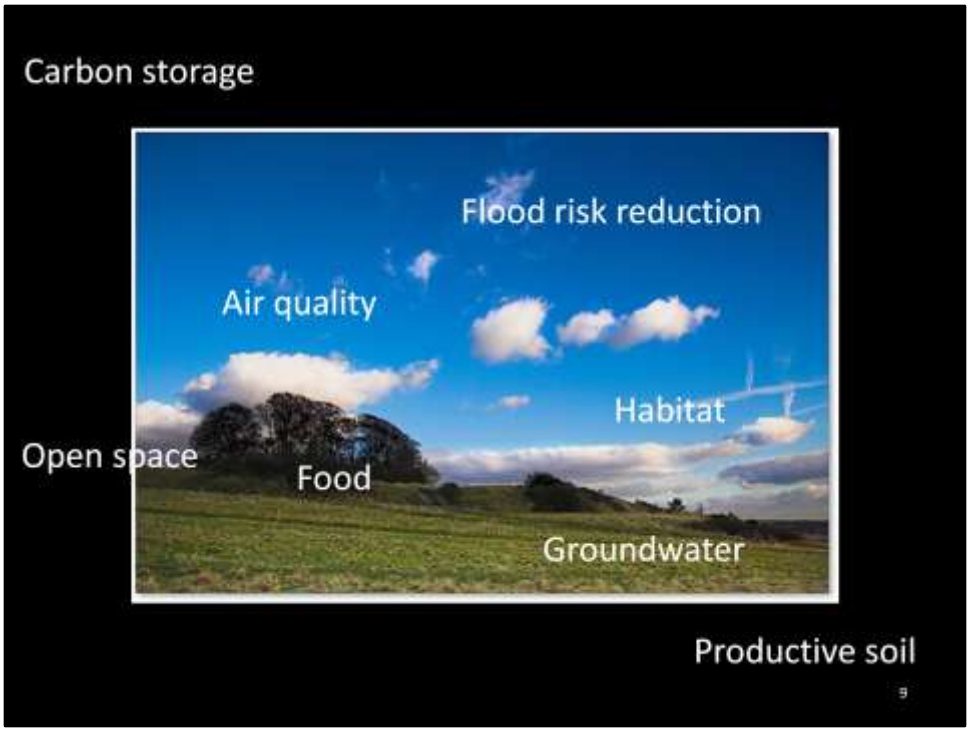
- The narrative process following the Deep Water Horizon, i.e. there are legal reasons to get values for awarding damages etc.
- Economists understand it and they are powerful folks who help frame policy.
- People understand dollars.
- Practical way to understand the damage going on in the Gulf.



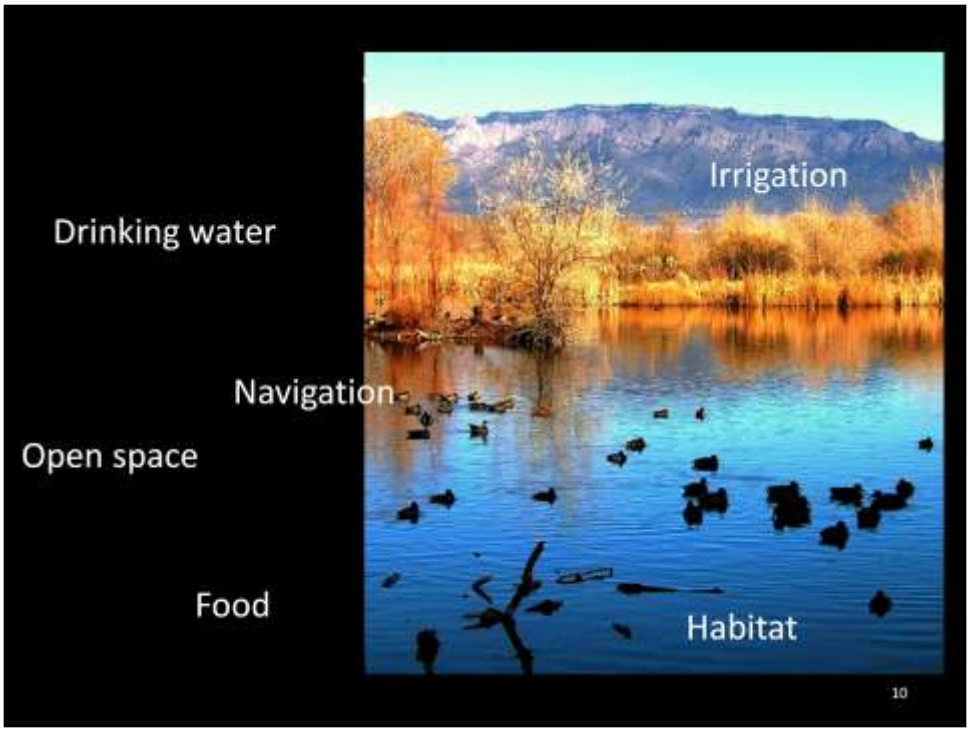
- To an economist, the fact that nature has value has been uncontroversial for a hundred years. Economists agree that the value of nature should be on the table and considered against other easy to measure aspects.
- The second point is from the reading and may be an older school argument for doing valuation: it is the rational science valuation of what is important to our society. The idea here is that valuation disciplines our politicians. I would say this is a naïve theory.
- The act of valuing nature also helps people make the connection.

- We are talking about valuable stuff.
- We believe that there is "stuff" like the objects pictured in the slide and most people understand and agree on the value of the "stuff," but … *[Boyd's point continues on slide 9]*

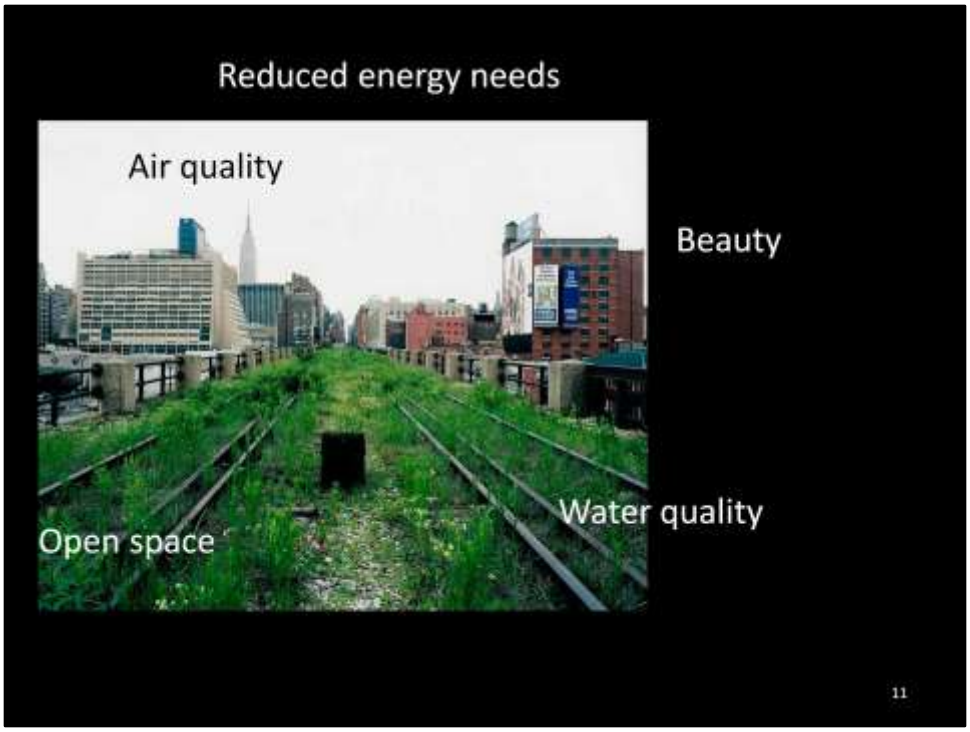

Ecological Wealth
• All around us
• Shared, common goods
• The foundation of all economic activity & human wellbeing



- *[Boyd's point continued from slide 7]*…. there are all these other things that are valuable that are harder to see, i.e. air quality, productive soil etc.



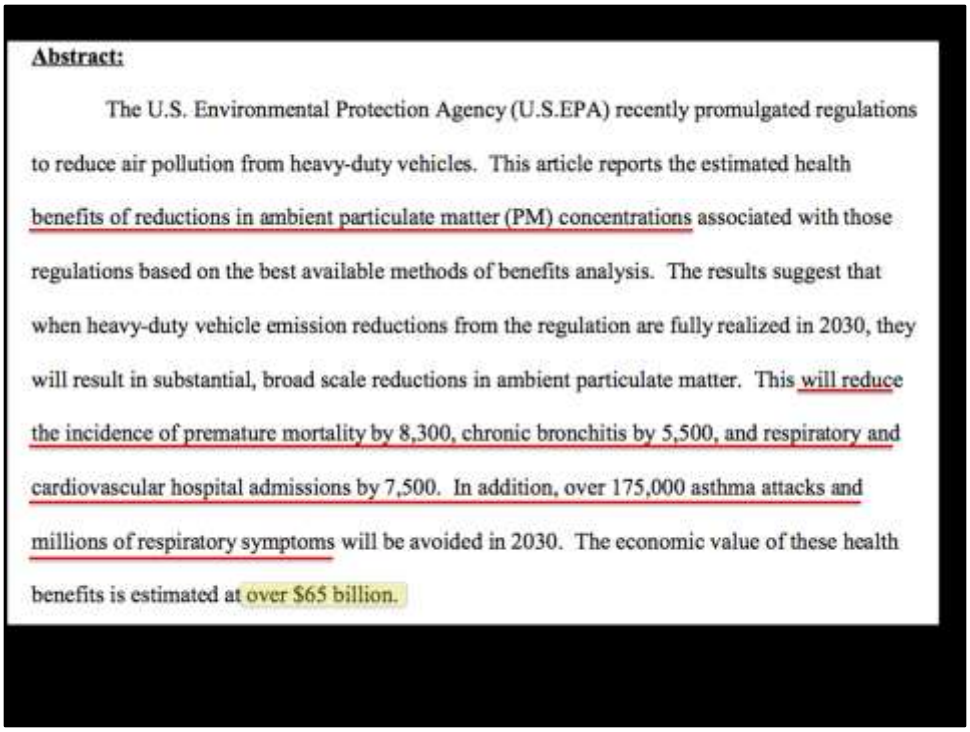
- They are public, non-market resources and what we are trying to do with valuation is to give life to those harder to see resources like air quality, open space etc.
- This image shows a different landscape from the previous slide, but tremendous value still exists no matter what the mix of elements.



- We are not just talking about wild nature either; New York City, Shanghai etc. also have these kinds of resource values.
- These values exists everywhere, they are just harder to see.

Back to the importance of valuation:

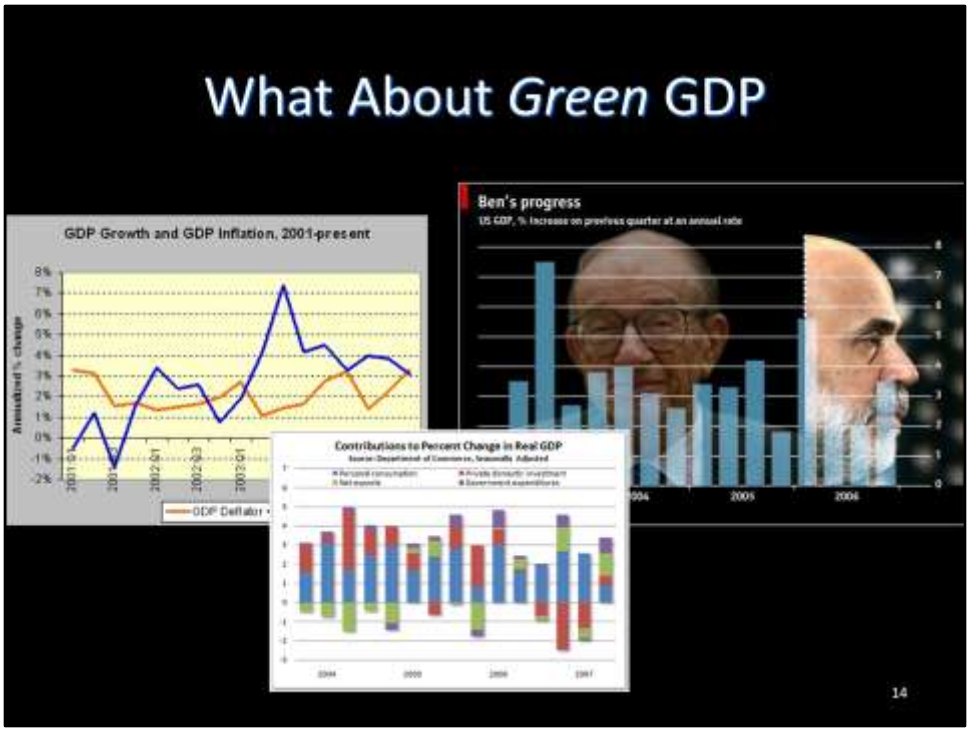
- It is important in any policy battle.
- For example, Wal-Mart will make a strong argument about the benefits a new store will bring to the community (revenue, jobs etc.). Essentially, we need a counter argument for a natural landscape. If we can boil it down to dollars, we can have an argument on the same level as Wal-Mart.
- This is another reason why we do valuation.



Abstract:

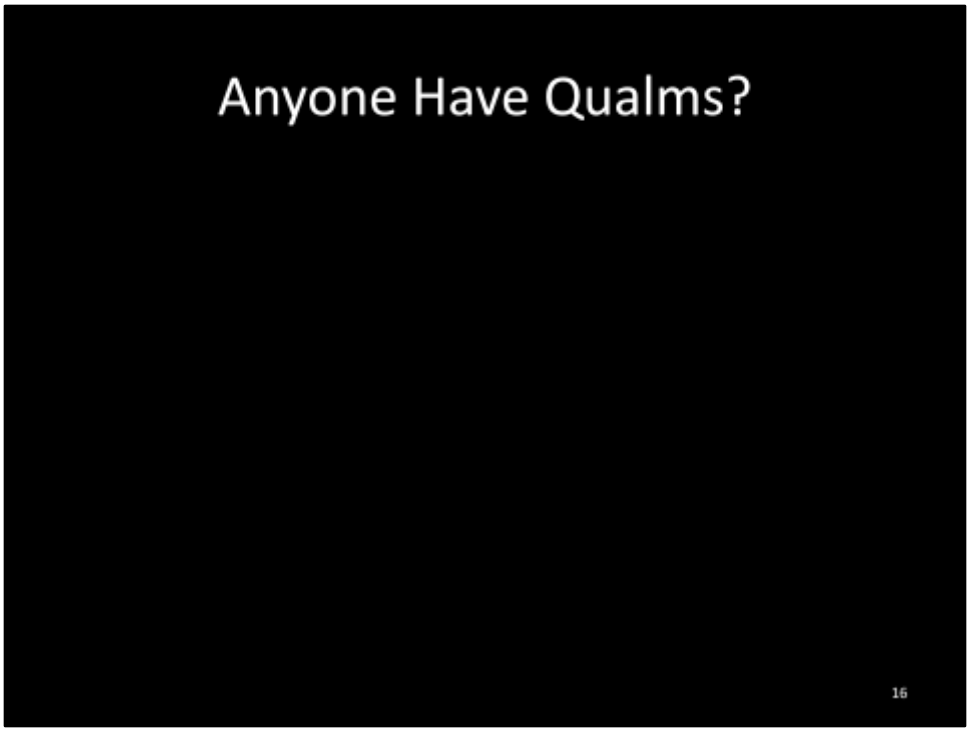
The U.S. Environmental Protection Agency (U.S.EPA) recently promulgated regulations to reduce air pollution from heavy-duty vehicles. This article reports the estimated health benefits of reductions in ambient particulate matter (PM) concentrations associated with those regulations based on the best available methods of benefits analysis. The results suggest that when heavy-duty vehicle emission reductions from the regulation are fully realized in 2030, they will result in substantial, broad scale reductions in ambient particulate matter. This will reduce the incidence of premature mortality by 8,300, chronic bronchitis by 5,500, and respiratory and cardiovascular hospital admissions by 7,500. In addition, over 175,000 asthma attacks and millions of respiratory symptoms will be avoided in 2030. The economic value of these health benefits is estimated at over $65 billion.

- This abstract is from a study done by the Environmental Protection Agency (EPA) and National Institute of Health (NIH). The EPA was thinking about tightening auto emissions regulations and did a multi-year study to calculate the potential impacts.
- The study showed that fewer people would die earlier and fewer people would get sick if the regulations in questions were in effect. The study estimated the benefits to be over $65 million. Obviously, this number is a powerful motivator and thus helps to push this kind or regulation forward.
- Now, imagine being able to do this for ecological systems and being able to show what can happen to real people and real economies and then put a dollar value on it.



- This is another trend we are seeing not just in the technical communities but also in the larger community: there is a growing sense that the way we measure our society is wrong. GDP does not cut it.
    - The more oil we burn, the higher GDP grows. The more fish we pull out, the higher GDP grows. GDP does not convey what is really going on.
- Valuation will produce more practical values. It will balance out our over consumptive behaviors to preserve future well-being. This idea of *green* GDP is another application with real legs in the international community.

- I am doing some work with The Nature Conservancy (TNC) and they are asking the following question:
  - We do not have lots of money to spend, where should we spend it to get the greatest impact?
- Typically, these investments have been oriented toward increasing biodiversity.
- Valuation is a way to capture progress and effectiveness of multi-faceted outcomes.
- Valuation can help direct investment.



- Does anyone have any problems with these ideas?

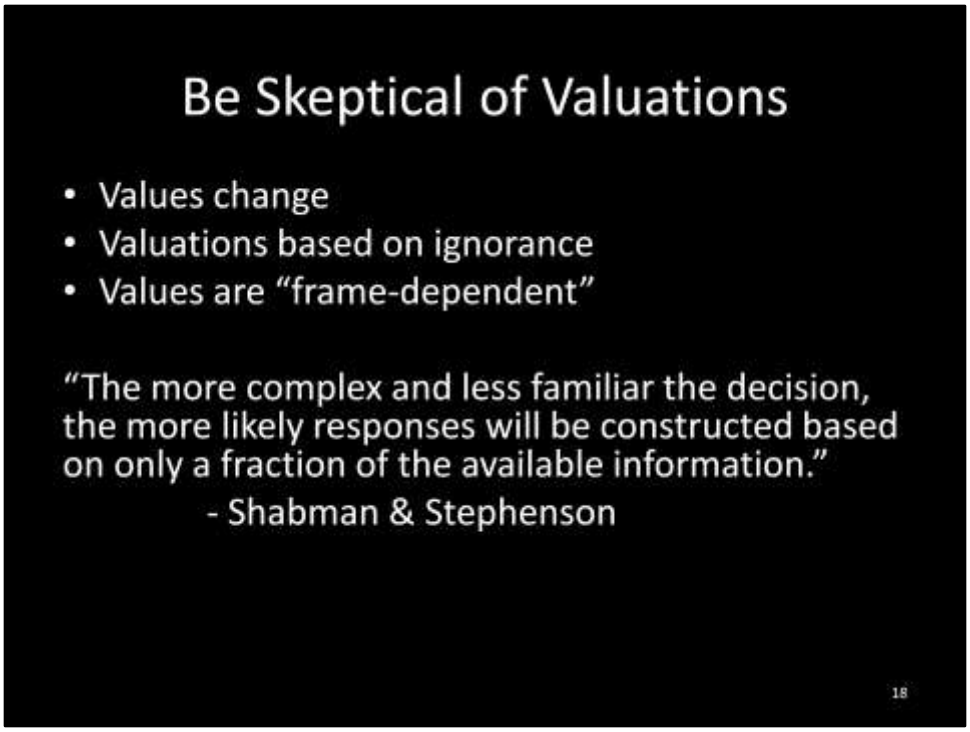
Group Responses:

- In the example where the EPA valued air pollutant regulation at $65 billion, clearly they were valuing lives. When you get to the point of valuing lives and using different risk assessment and different discount rates I get uncomfortable.
- Value to whom? Who gets to make the decision? There are issues with equity and equality that make me uncomfortable.
- The illustrations you have shown are about viewing nature as a bundle of services, but there is something important about fitting them together that is valuable in itself.
- Maybe it is the opposite, i.e. by not considering nature and dollars, we have undervalued nature.

Boyd's Reply:

- There is a tendency to deconstruct a system in order to get a handle on it. There is a desire to define each specific good and service. This is a struggle because psychologically we are drawn to the totalitarian way of thinking about nature. I will not defend the desire to deconstruct systems but I will recognize that it poses huge problems for economics.
- This goes beyond the value of nature as well. If you think about cars, they are bundles of goods too. One thing I am starting to do is work with marketing people to see how they measure and design products and how they reach people. In addition, I think this is a great future research question and one our society has not grappled with enough. I hope that we can come back to this issue.

- There is a big difference between value and *values*.
- When we invade a country, we do not actually do a cost-benefit analysis. We do not put a price on freedom.
- For some of us, valuation can feel a little strange. We will do it for a variety of reasons, but we should not forget that valuation may reflect a set of *values* and our donor communities and stakeholders may feel accordingly. This process continues to cause people problems and we should be sensitive to that.
- Last point is depressing: Does anyone actually care?



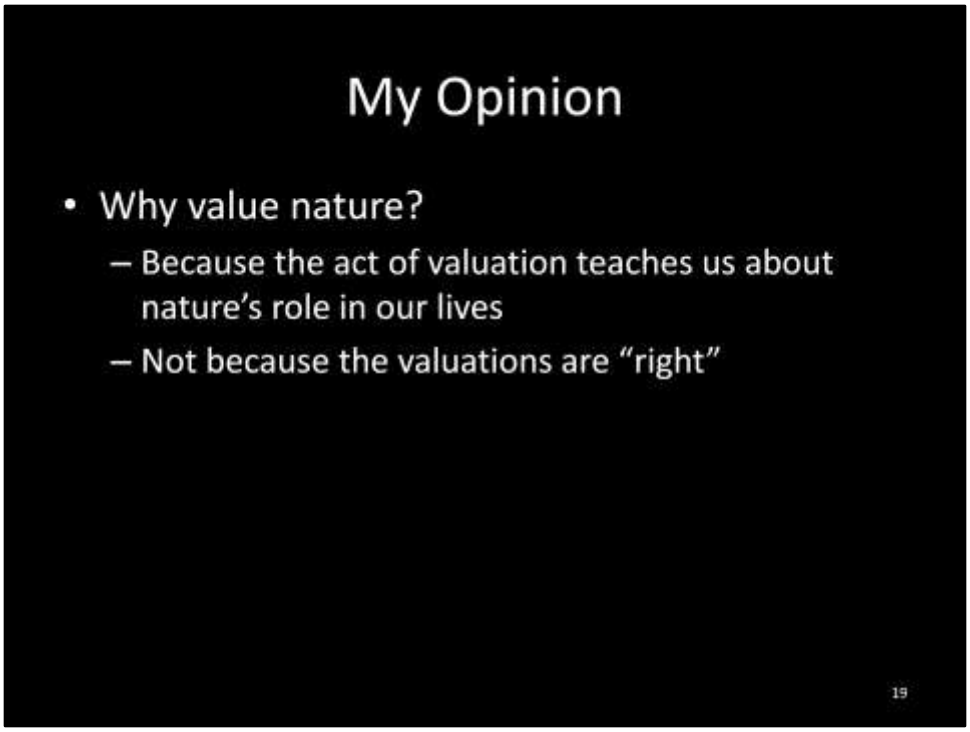
- As we talk about skepticism, I want to leave you with **positive skepticism** today.
- The three points listed on the slide are probably obvious, but they are important to remember. They are particularly important when quoting a study from 1985. Values change with time and we need to recognize that. Values can be influenced through social marketing and are always changing.
- Valuation is based on ignorance – this is another reason to be skeptical. When you actually try to tease out the valuation reasoning, it is a slippery process.

Group Comments:

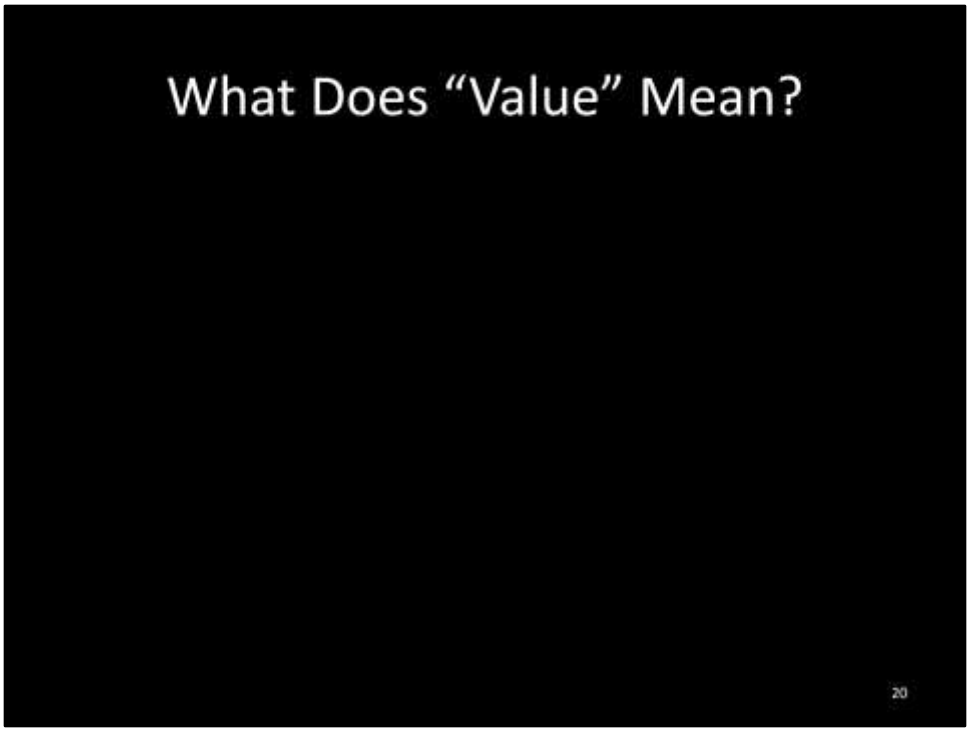
- I have a business background, and business people are trained to make decisions despite the existence of unknowns and high uncertainty. You are taught to make a decision, move forward and then you learn based on what happens. It has always been puzzling to me that people have an objection to this because the alternative is to do nothing and then have a value of 0. It is better to try than do nothing; the business community can do this very adeptly.

Boyd's Reply:

- Thank you for bringing that up. A lot of the work comes from a very scientific and technical community and we tend to overcomplicate and overanalyze. We are worried about not being published and about what our colleagues will think. Many of our stakeholders are not ready, but we have to get to the point where we make decisions because it will never be perfect in the end since values change continuously.



- When you do valuation, you learn a lot about nature and human well-being.
- I look at any number with skepticism because I know how the sausage is made.
- We need to work together to better tell the story.



- Now I would like to talk about a few misconceptions.

- Valuation is not about business or making profits, it is about more than that.
- Valuation does not always have to be expressed in the final $ amount. Dollars are merely a yardstick.
- Government is not acting on valuations; valuations are not THE decisive factor. Valuations are one element that goes into the calculus.

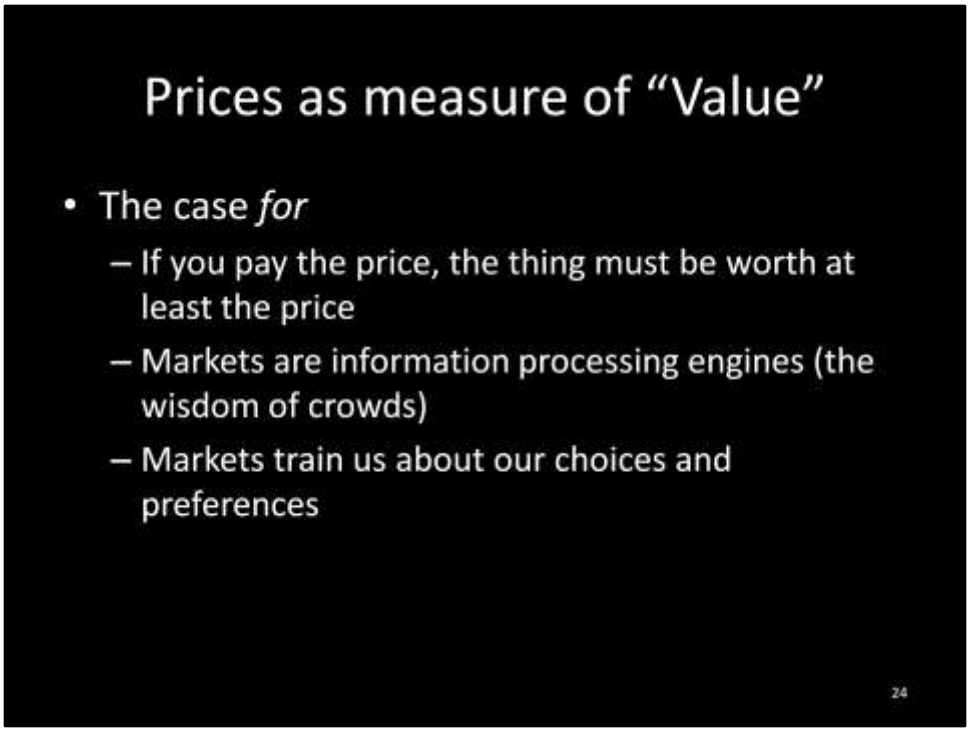
- Does this value bother anyone?

- My hypothesis is that it is not controversial.

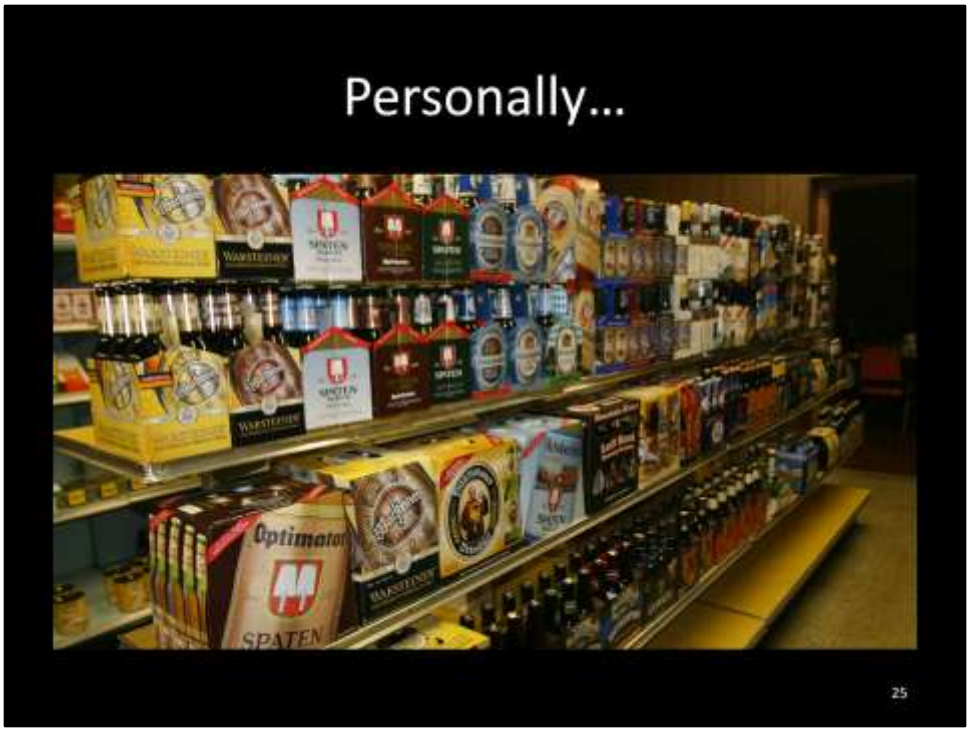
- Now if I say the wetland is worth $28,000 does your emotional or intellectual comfort change?

Group Responses:

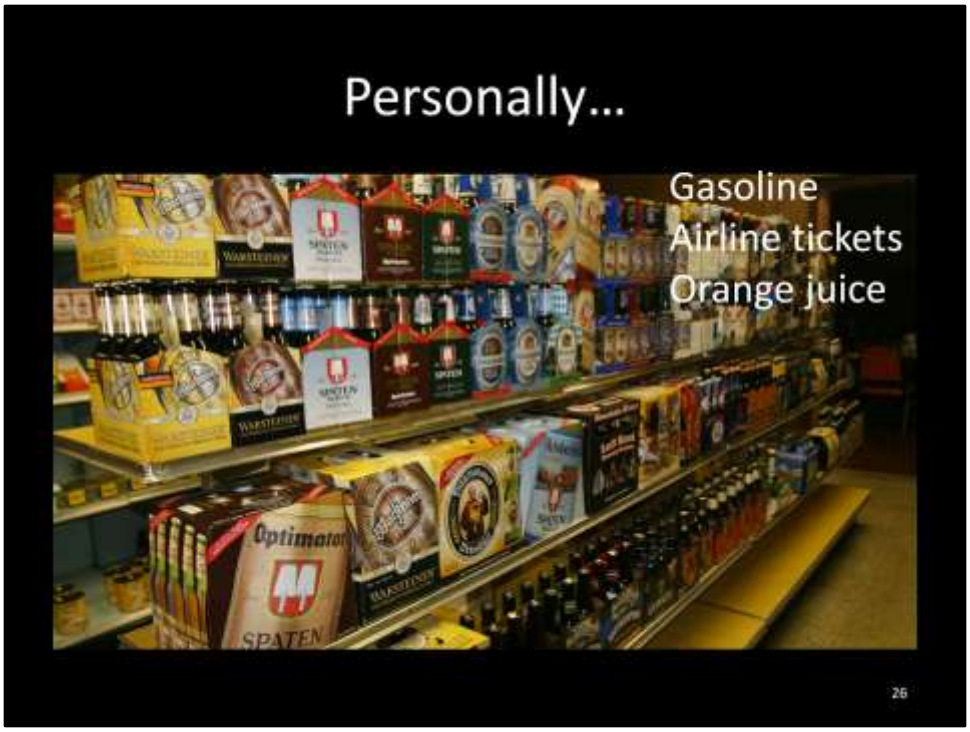
- From my experience with wetlands, the value seems low.
- I observe the Prius in other markets for about $28,000 so it makes sense to me. On the other hand, I cannot go out and see similar prices and valuations for a wetland, so I do not feel comfortable with the price.



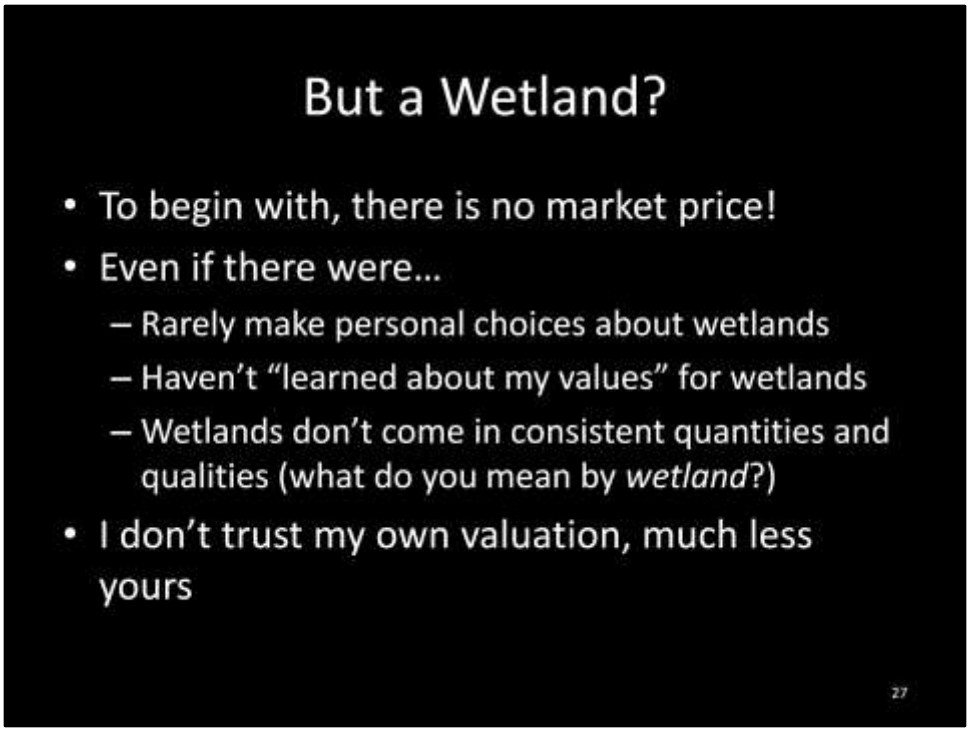
- In a market situation, you are forced to confront choices and options and the value of those differences. This is why prices are a good measure.



- I interact with markets regularly and frequently when I buy beer.
- I know quite a bit about what I value for certain kinds of beer because I have compared prices and I do it regularly. Through my regular market interactions, I have been training myself to think cognitively.



- The same is true for gas prices. As a society we are regularly confronted with gas prices; they are posted everywhere and it drives politics. There is some experiential valuation components to it.
- Most services, we value more episodically, which makes the prices more difficult to demonstrate.



- There is no market price for a wetland right now.
- There are some costs to wetland restoration but in general, we are inexperienced about how we value wetlands.
- We rarely make personal choices about wetlands.

- Another important issue is how direct experience influences the value.
  - If I live there and/or I walk there, I will value the wetland more than if I had little interaction with it.
  - One's direct experience is a big part of value but so are the contributions the wetland has to larger components like flood mitigation, habitat creation in an estuary 10s or 100s of miles away.
  - The wetland's roles in production that are harder to see create big problems for valuation and we need to be conscious of them.

- Prices are a lower bound on something.
- For example, I have an iPhone application to play guitar and it only costs $20. To me that application is worth much more than just $20. It is worth the total cost of buying the guitar, the amp, and the various distortion pedals. The application is worth hundreds to me and I bought it because it costs less than what it is worth to me.


Startling Statement 1: Heal
"The market price of a good does not tell us how important that good is to society."
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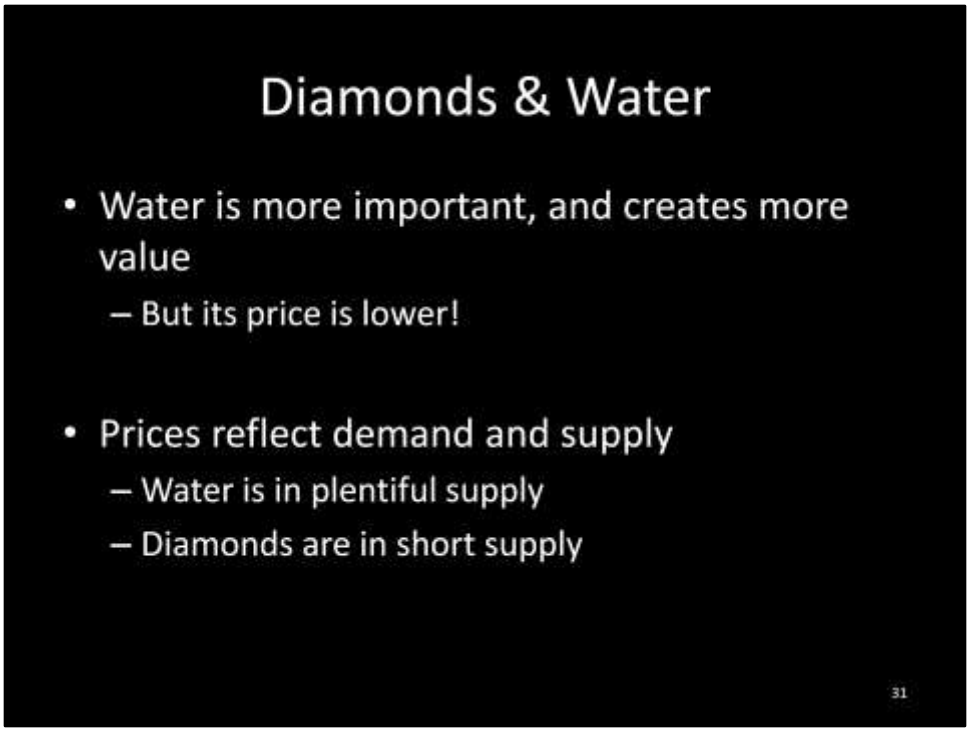


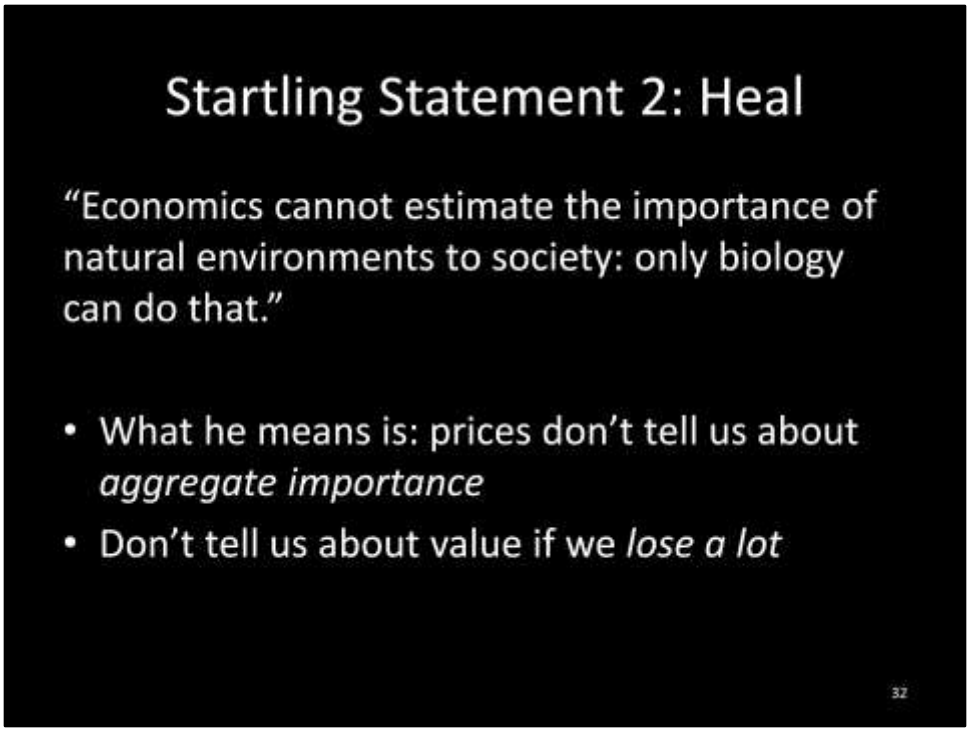
- This demonstrates the diamond and water paradox. It tells us that supply and demand are relevant: the supply will affect the price.
- When dealing with economists, scarcity is important! It is what we use for our "triage." The things that traditionally motivate conservation (biodiversity, wild nature) are the scarcest.
- Fresh drinking water is an example where we will be able to use technology to get out of the scarcity box, i.e. desalinization processes etc.

  - In your roles as people of conservation, can you give some examples of what you think are diamonds and what are examples of water?

Group Responses:
- Diamonds: honeybees and functional riparian ecosystems (in CA they are extremely scarce).

Group Comments:
- What if we do not want to accurately value an ecosystem? Maybe I just want to buy that ranch for $X? If I look into all the benefits of protecting the land, its value will increase and I will have to pay more for it. So why do I want to go out and find the real value if it might be worth more than the market value?

Boyd's Response:
- That is a good question and something you confront in markets every day. When you buy a house you do not tell the seller how excited you are about it because you want to get the lowest possible price.

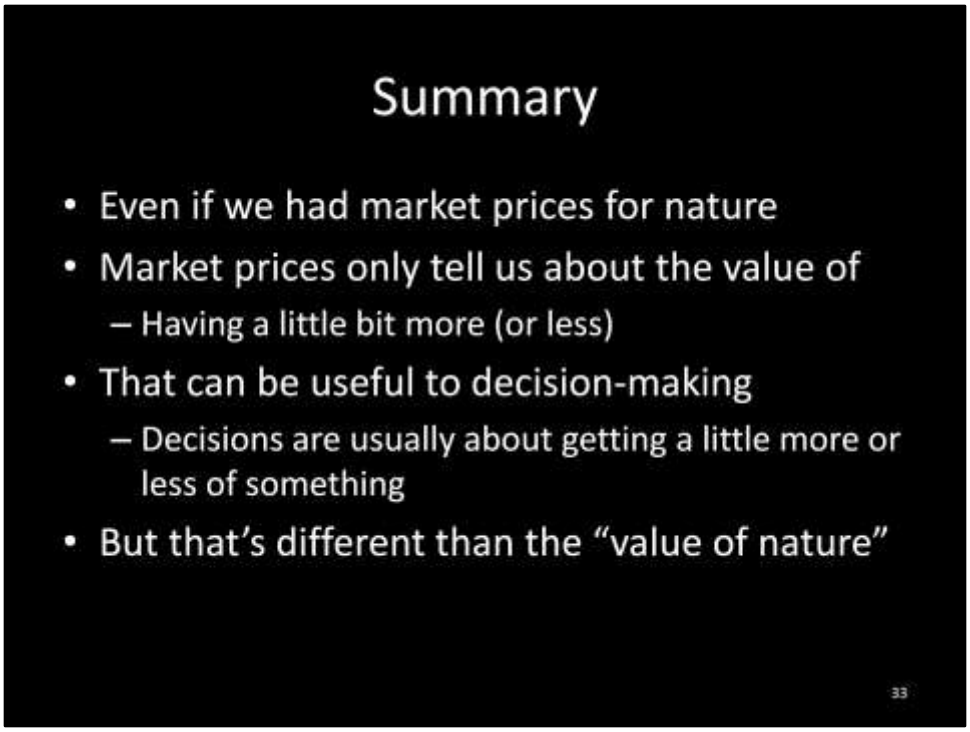


- This is the diamonds and water theme again. Prices and economics tell you about the marginal changes (i.e., if you change a little here and a little there, the price will rise and fall this much).
- What it does not tell you is about losing a lot of something. We do not have the evidence base for big changes, i.e. prices cannot say anything about losing all freshwater.

  - Does this statement frustrate you?

<u>Group Responses:</u>

- This is the idea that nature is too big to fail. Similar argument for the bank bailout.
- That is the climate change debate right now as well.


Summary
• Even if we had market prices for nature
• Market prices only tell us about the value of
– Having a little bit more (or less)
• That can be useful to decision-making
– Decisions are usually about getting a little more or less of something
• But that's different than the "value of nature"
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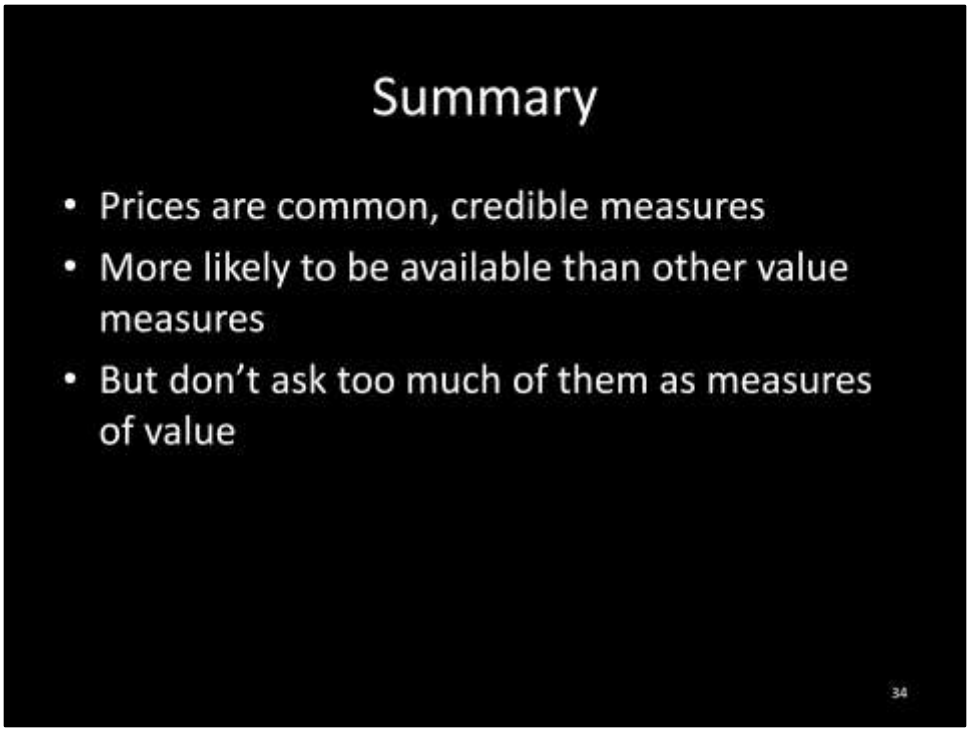
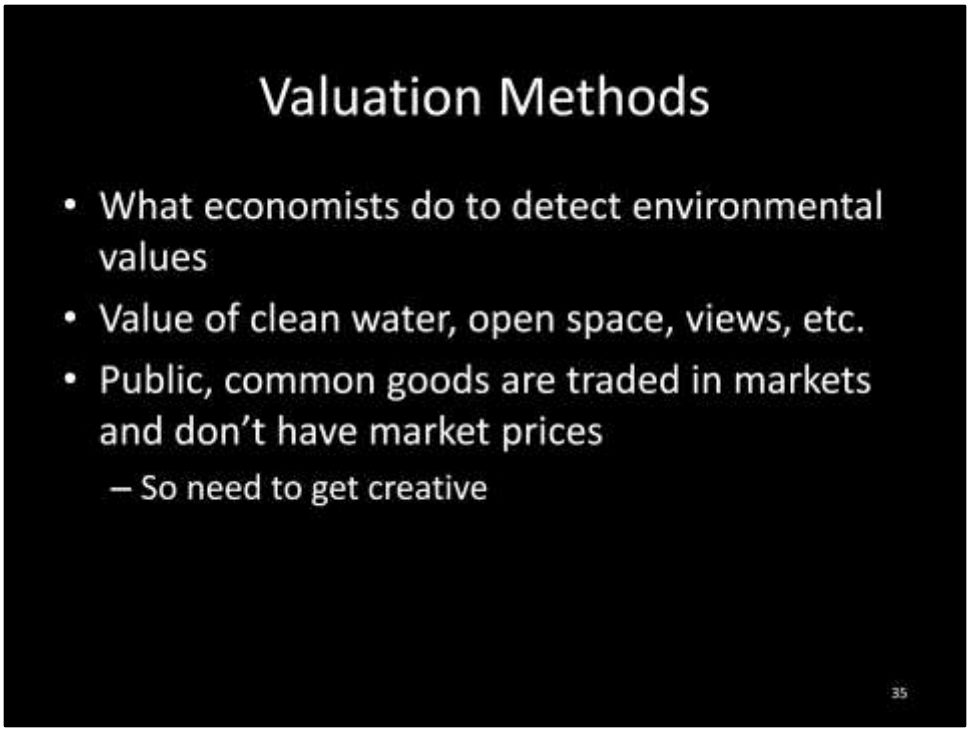
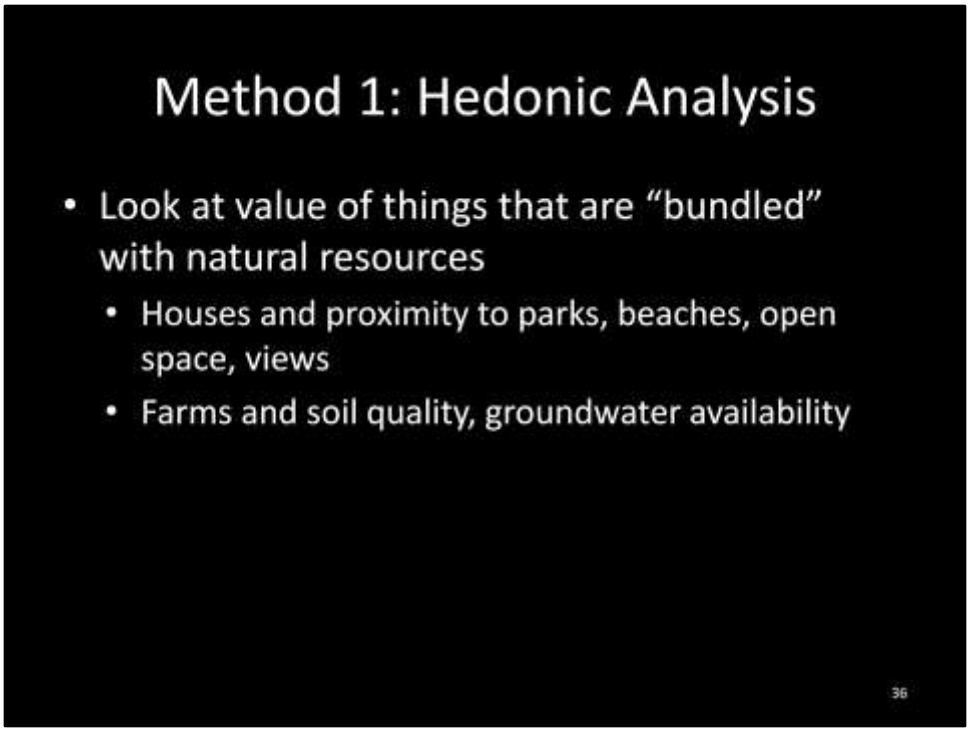


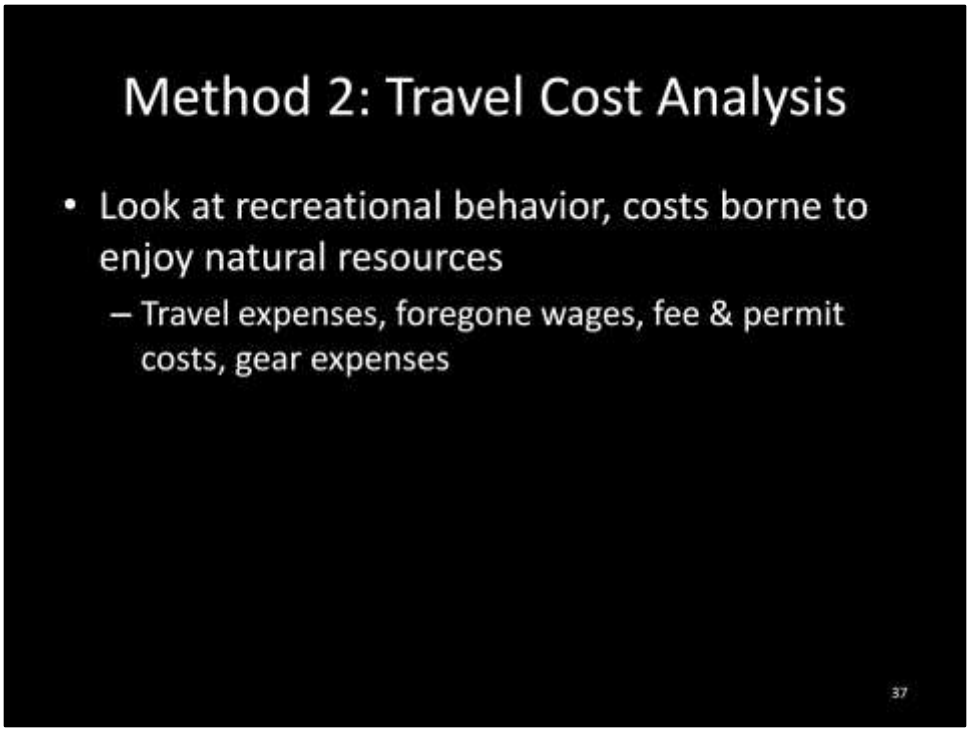
- Prices are common and credible, but you cannot ask too much of them. We use prices for specific reasons.
- Prices are not synonymous with value or values.



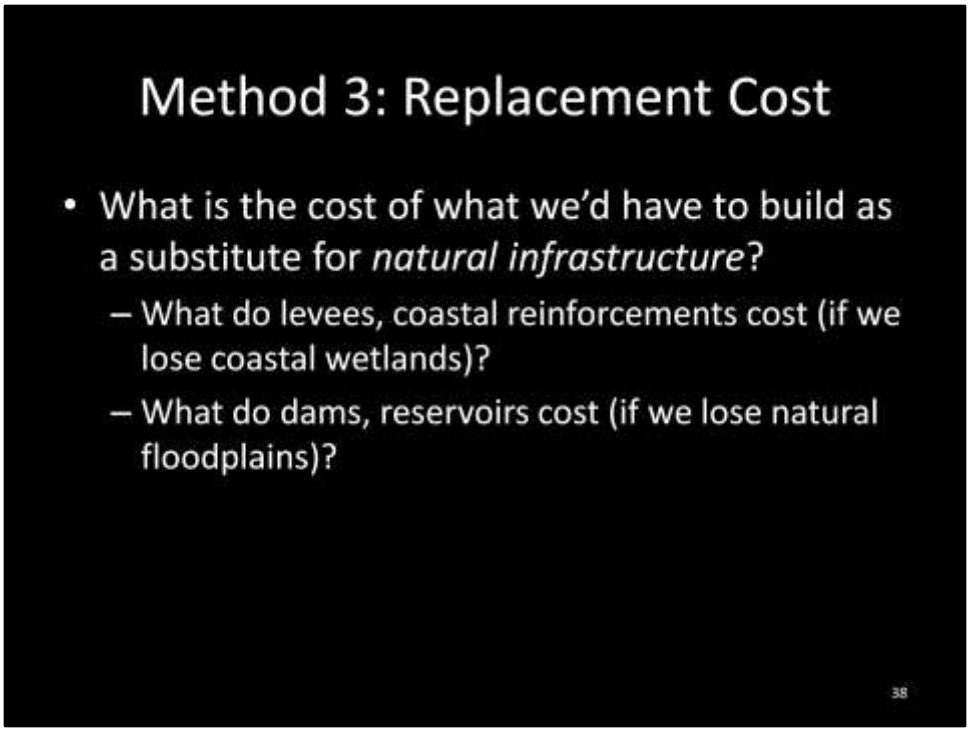
- The problem is that we do not have markets buying and selling this stuff. We do not have the data so we have to get creative to give it a value. Here is how…



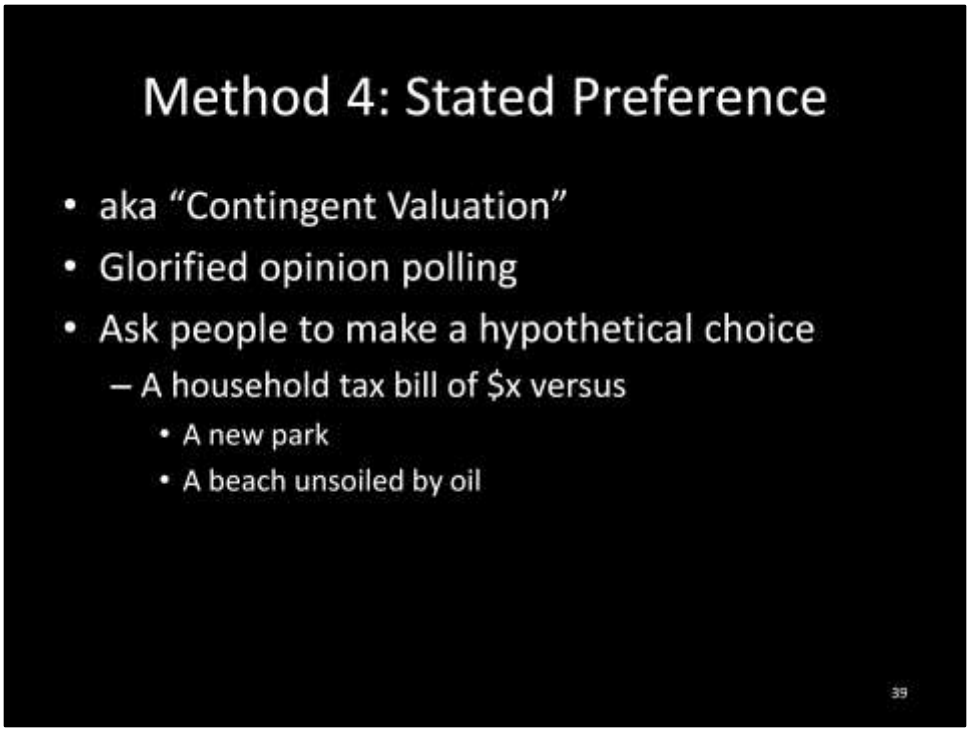
- In the first method, you relate housing values with associated amenities.
  - Palo Alto is a prime example. If you hold number of bedrooms, presence of a garage etc. constant, how much are houses valued here in comparison to same thing in a place without mountains and less open space?



- In this method, you look at how much people spend to go to the beach or to go fishing or how far they travel to get to the place in question. Essentially, you are trying to estimate how much people are giving up to go spend time at the location of focus.
- This estimate then becomes the lower bound. If you are spending at least that much, it must be worth more for you to give it up.

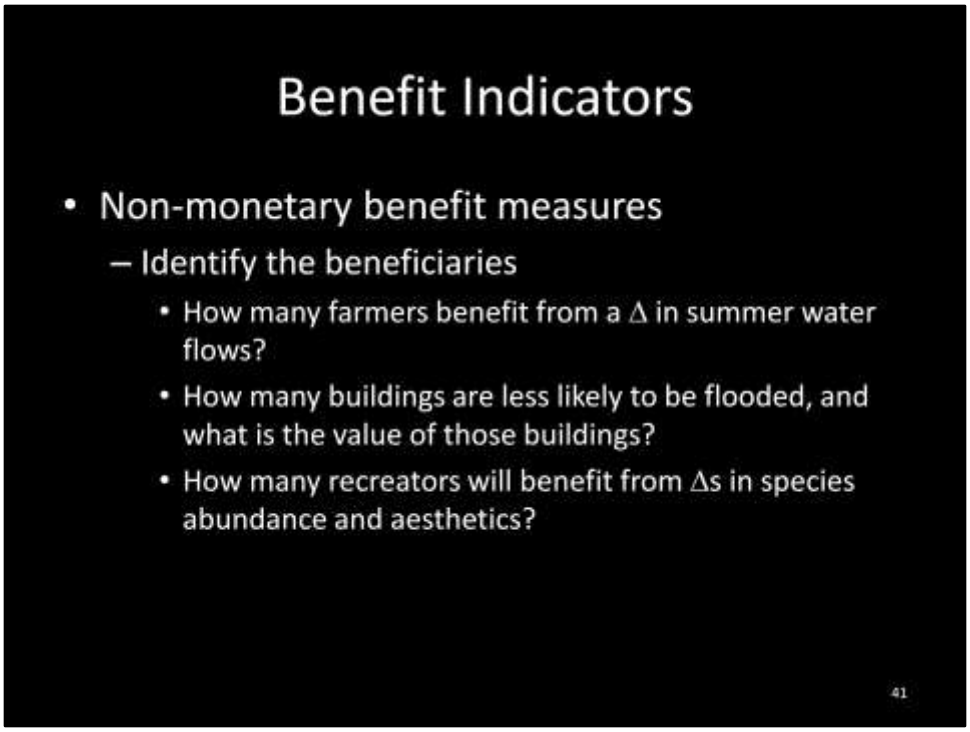


- Catskills watershed is the best example of this type of valuation method.
- For example, if we are looking into how to best lower New Orleans' flood risk, we can estimate the value of protecting the wetland by interpreting the cost of building levees around New Orleans. Then the cost of protecting the wetland is at least the forgone cost of building the physical infrastructure.



- This method is essentially just very structured opinion polling.
- There is a lot of literature on how to do this.
- The shortfall to these kinds of studies is that the people interviewed are not really putting their money on the line and you can run into the issue where respondents answer in a way to please the survey giver. However, there are ways around those errors.

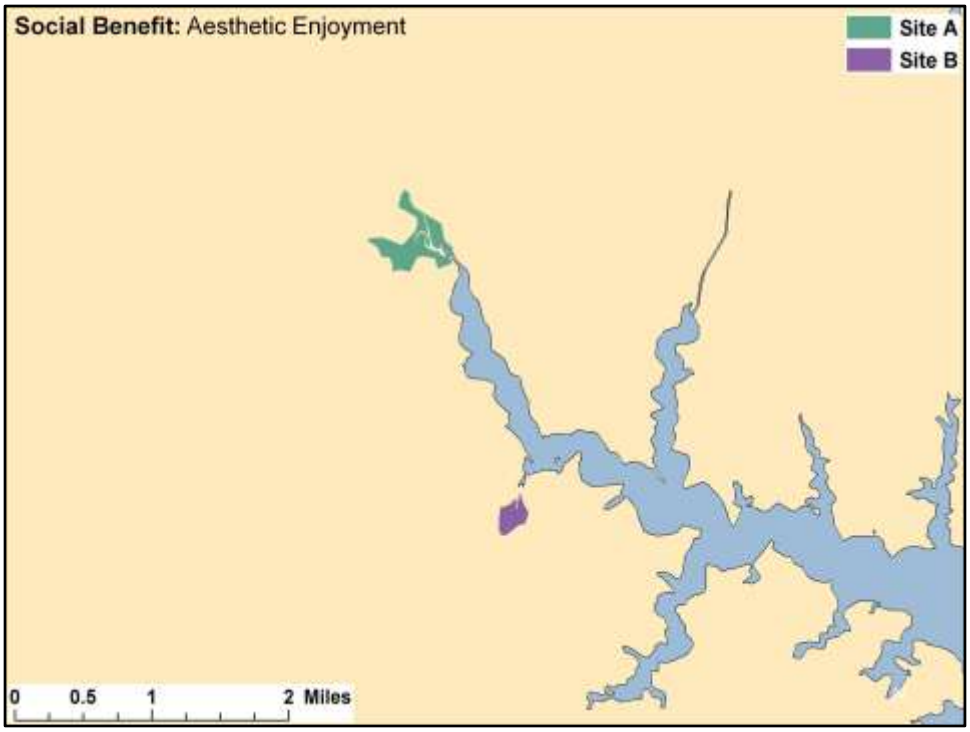
- I want to spend more time on non-monetary valuation.
- The idea is that there are quantitative things we can do to tell the story about how ecosystem goods and services are affecting people. I call them **benefit indicators**. This is another way of conveying the benefits of nature and I think this is a strategy worth pursuing in certain contexts.



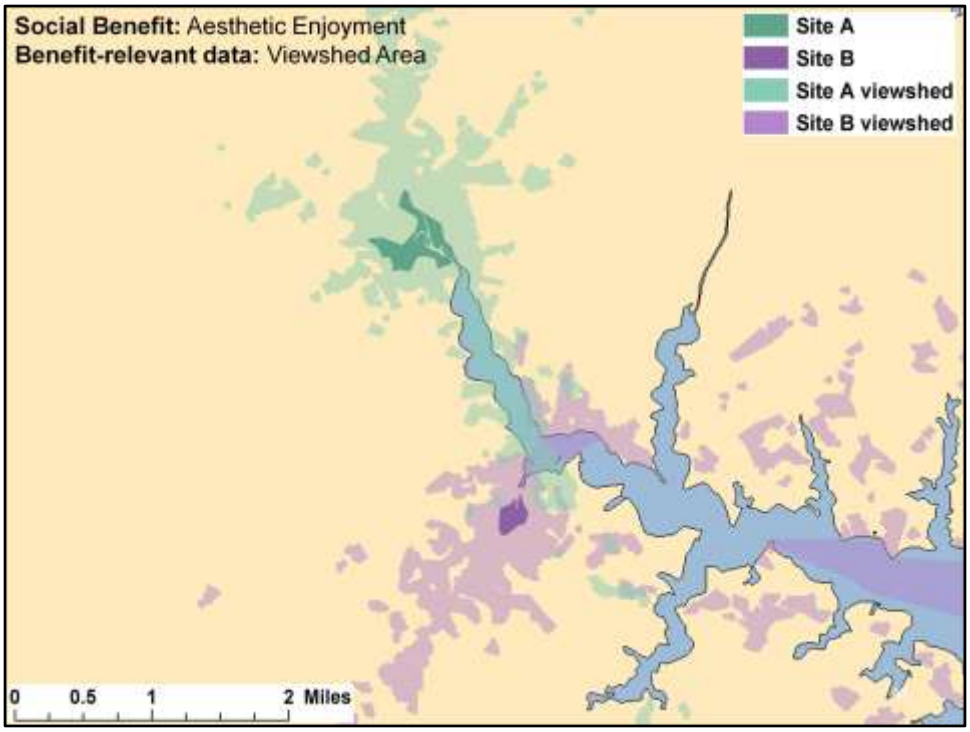
Let us work through an example…

- If we manage the forest or watershed in a certain way what will happen?

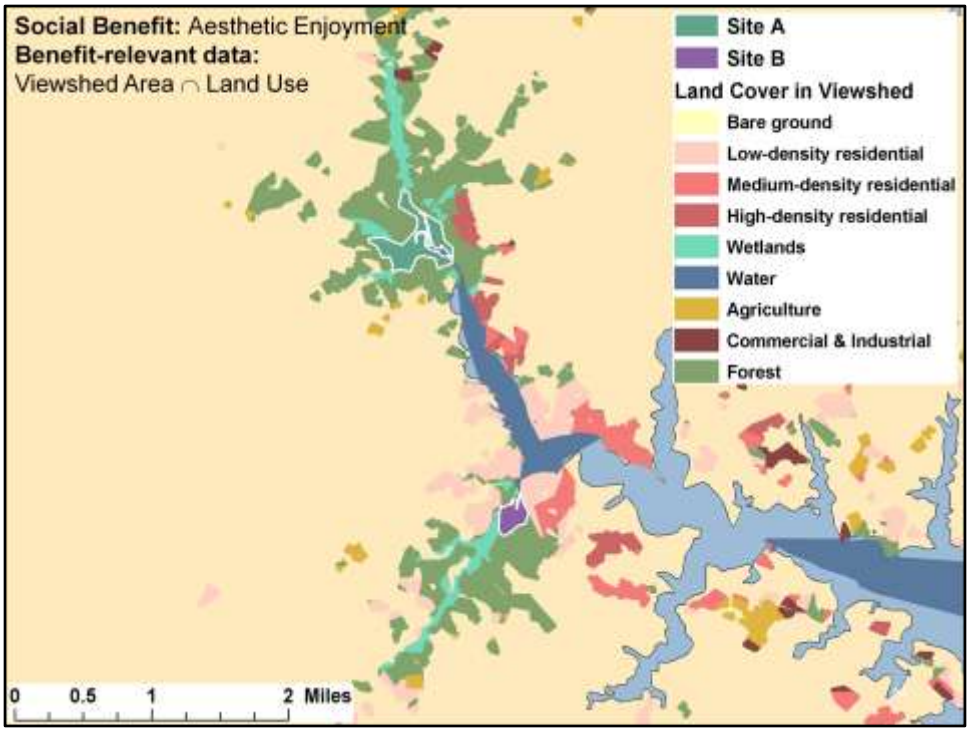
- If we can get farmers to store water on their land, they may get more water when they need to irrigate in summer months.
  - How many farmers benefit? How many households?
- It is relatively easy to get the information of how many will benefit: you count them!
  - We have data on how many people live in certain areas, how many people visit parks, and how many people drive on 280 etc.
- We can look at this data to estimate how many people a new type of watershed management will affect. The whole point is that you want to connect beneficiaries with benefits.



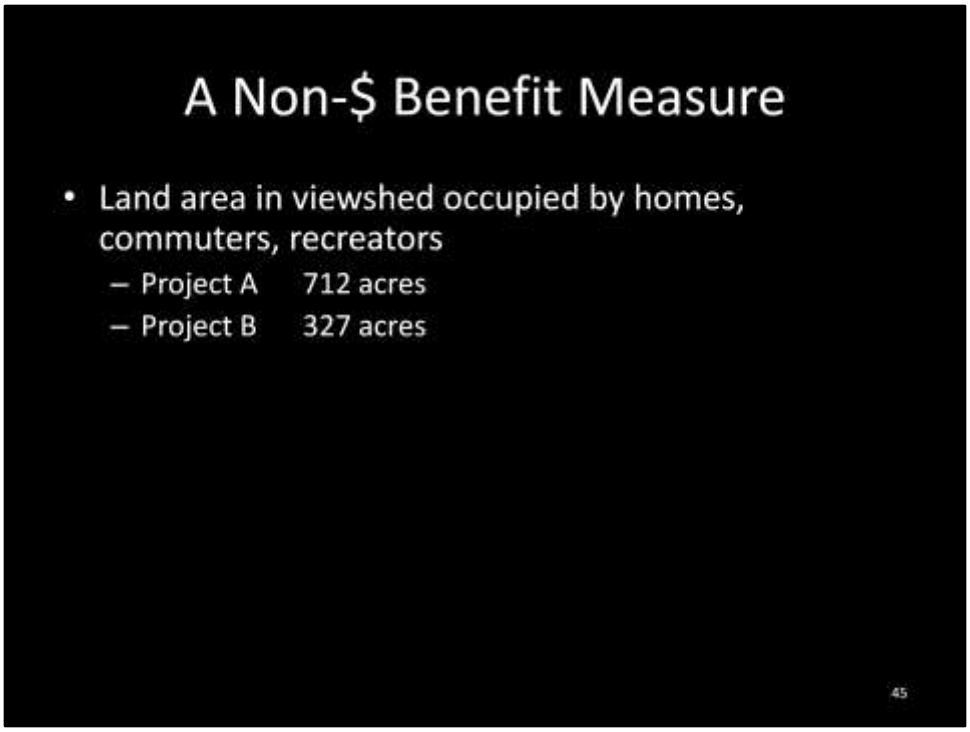
- This is an example of visual and numerical components and how it might affect the analysis.
- We have two sites: A and B. We have to choose one to protect. Let us look at benefit indicators to decide which site we should protect.



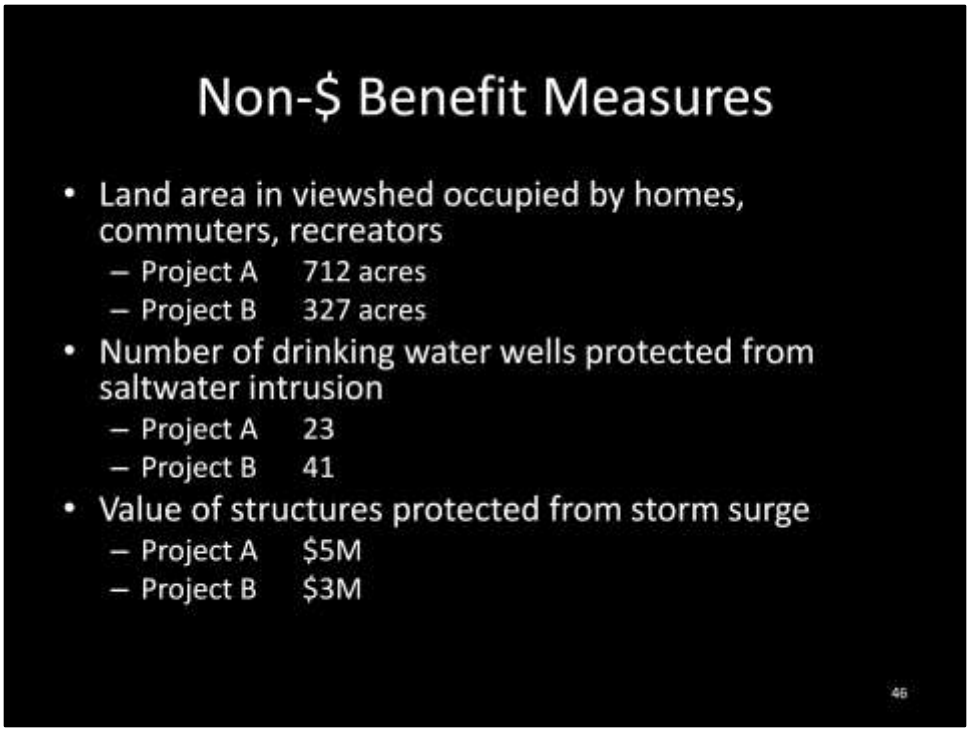
- First benefit indicator: visual access.
  - Identify which areas can see the protected area. This is easy to do with GIS.



- Second benefit indicator: land use.
- With this indicator, we go a bit further in depth and see the kind of land in the view shed.
- From this, we can get a sense of how many people will enjoy the protection of site A vs. B.



- Now we have information that begins to tell an economic story.



- So again, this is quantitative and easy to measure and helps to tell the story about what is going on in this area and in the context of choosing which site to protect.
- Imagine now you are in a planning meeting and someone gives you this information rather than the final value.

- Here we see a final dollar value obtained from protection site A vs. site B.
  - ➢ Which method do you prefer and why?

Group Responses:

- The previous example that lists the benefit indicators is more comprehensive and seems to be easier to work with.
- The single dollar value is made up of many implicit components and is amorphous.
- From a public policy standpoint, it is helpful to have the different perspectives explicitly stated as in the benefit indicator method. It also opens the possibility of different solutions. Maybe a solution is buying those homes and doing something else at the same time.
- I agree. You do not really learn anything from the number. The non-monetary way allows you to engage your own intelligence and allows you to present and utilize the information in a stakeholder process.
- With the benefit indicators, you now have to argue about the components and what is worth more. The politics are out in the open. The dollar value is deceptive. What if you could estimate the values across a range of different weightings? People run the risk of arguing about how much a water well is worthwhile forgetting the main issue.
- We need to keep our eyes open. These are benefits that address risks that

sometimes should not be there in the first place, i.e. we are calculating benefit of flood risk aversion for houses that should not have been built in the flood plain.

> ➢ Should we give this presentation to the business community rather than the conservation community? One reason we started to give nature a value was that it gave us a way to talk to the business community.

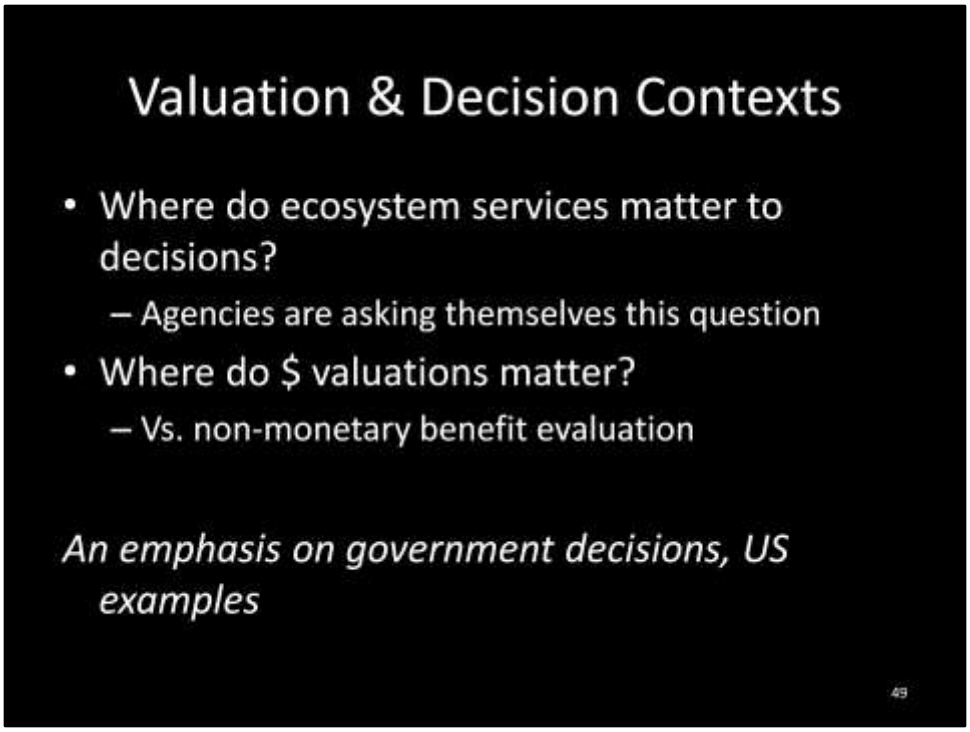
- Boards of directors of public businesses are legally required to maximize shareholder value. They are not in the business of maximizing social value rather they are in the business of maximizing their own value.
- Some fraction of the value will benefit businesses, some fraction will benefit landowners, but you do not see that in the dollar amount.

> ➢ Can you explain whether these two methods are mutually exclusive?

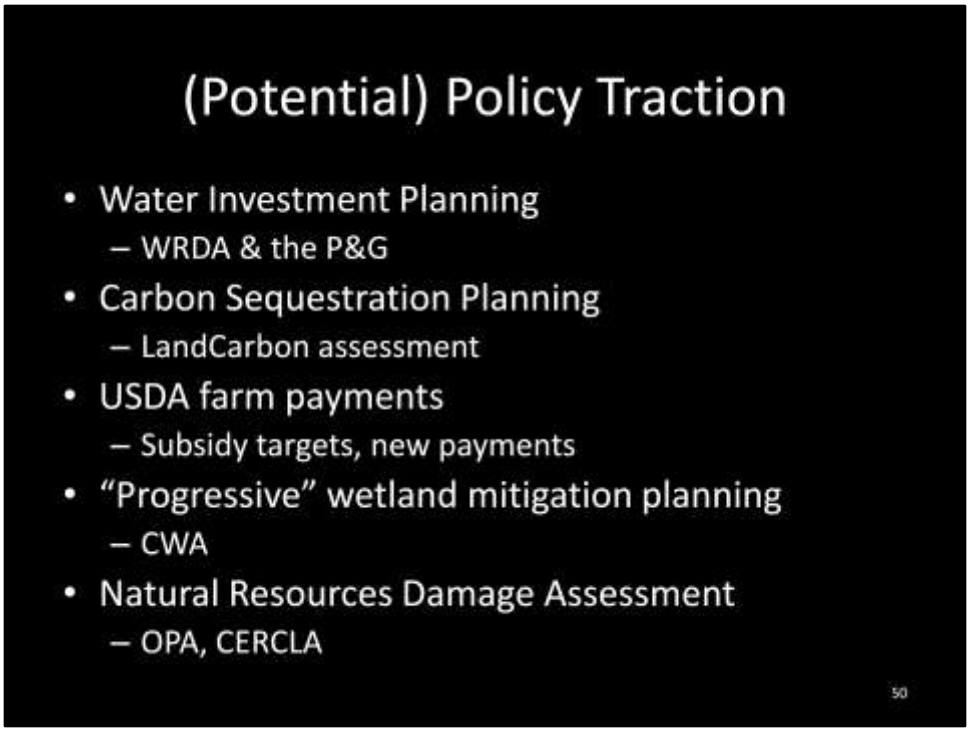
<u>Boyd's Reply:</u>

- Ideally, you want the best of both worlds. You would do both methods and they would talk to each other. I do not want you to walk away thinking these are mutually exclusive, but I do want you to recognize that people spend the lion share of time on the final dollar method instead of the one that utilizes benefit indicators.
- Benefit transfer is when you take the valuation study someone did somewhere else and you try to apply it in a new place. This depends on how similar the objects are between sites.
- It will not get you around fundamental conflicts. For instance, it will not inform you on whether we should we be moving away from people because the land is cheaper and there are intact corridors or if we should bring this home into people's yards and get more "economic" value. It is designed to illuminate this scale.

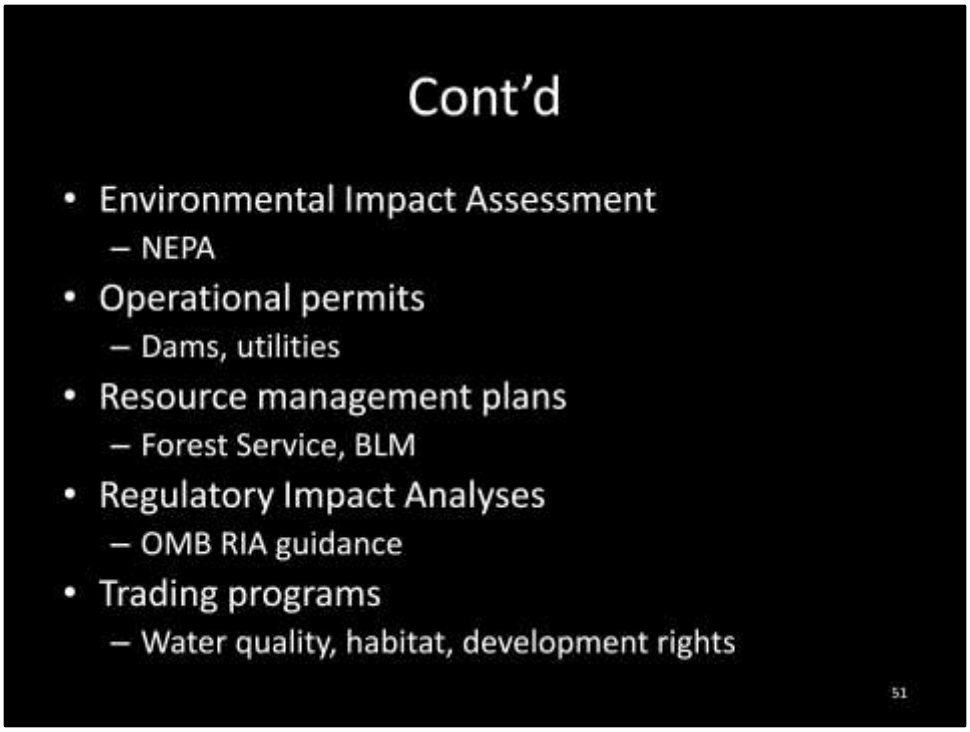

$ Monetary Valuation $
• Can
– *Obscure* nature's value
– Bore people
– Disenfranchise stakeholders
48



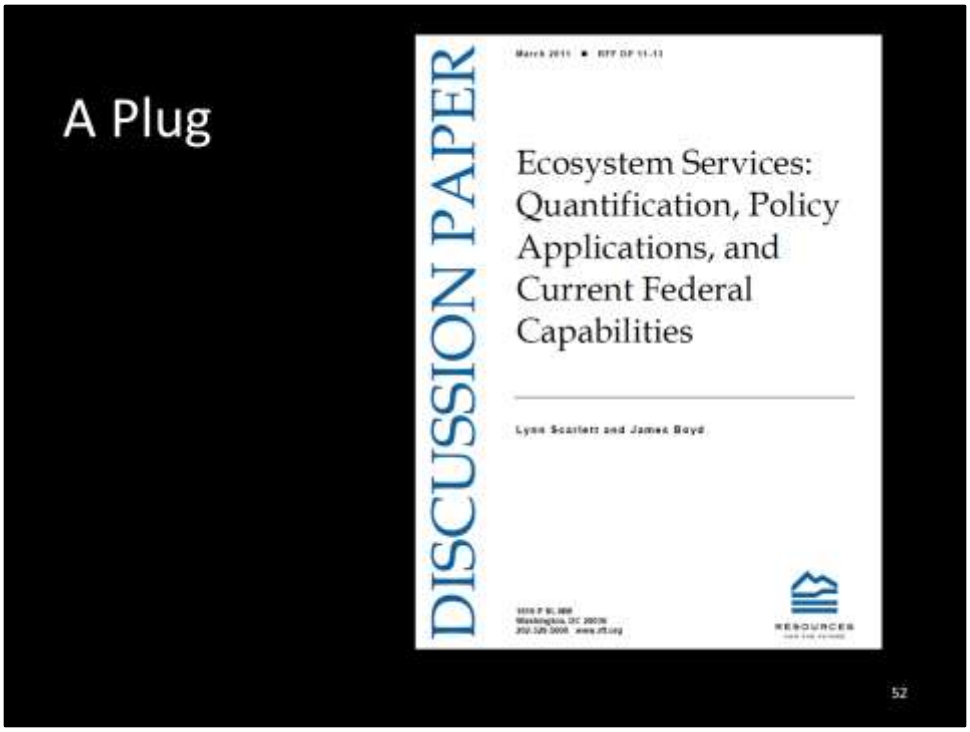
- There is a hunger for this type of work.



- There is a huge amount of applicability and hunger for this. I list a few examples on the slide. I will focus more on opportunities in government.
- People are talking about what they will do with the valuation once they get it.
- Water Resource Development Act (WRDA) has a lot financing for water projects and affects entire surface water of US. They reevaluate it every two years and it is governed by the Principles and Guidelines document, which now mentions ecosystem services throughout. It primarily asks the Army Corps of Engineers to include ecosystem services when they plan and finance these projects.
- United States Geologic Survey (USGS) was asked by congress to give a map depicting where and what to plant in order to hit carbon sequestrations targets. Now they are working on building co-effects into planning
- Unites States Department of Agriculture (USDA) has targeted payments and there is talk about revising them.
- Clean Water Act (CWA) is taking a regional more ecosystem-based management approach. If you can put the value on these, it will help.
- The laws will be pretty flexible and welcoming to valuation.

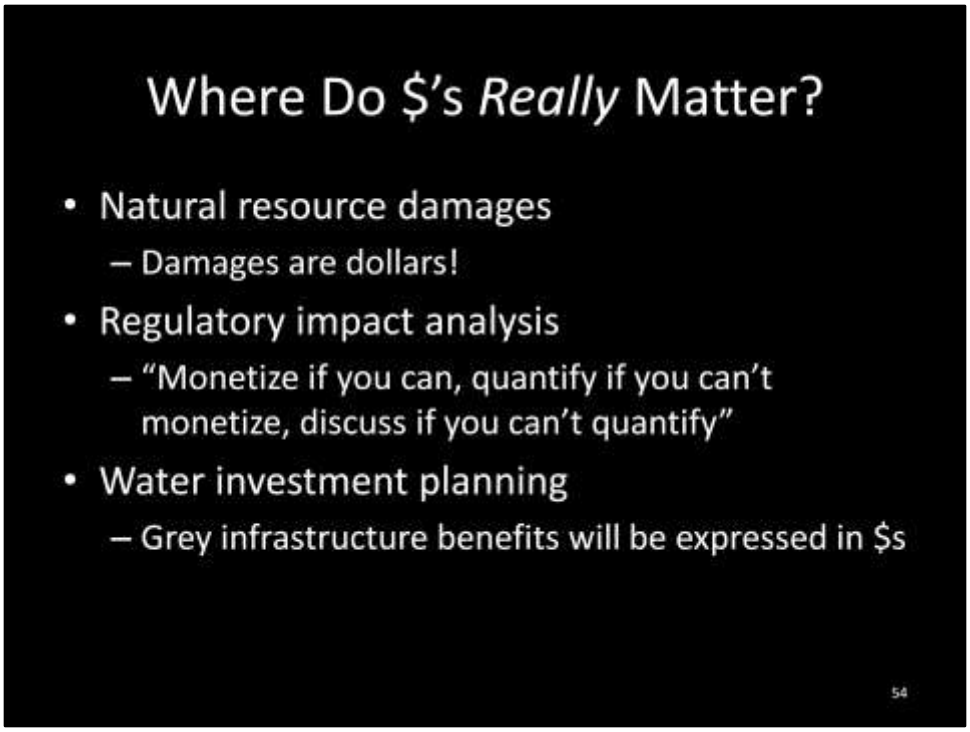


- This slide lists some additional opportunities.

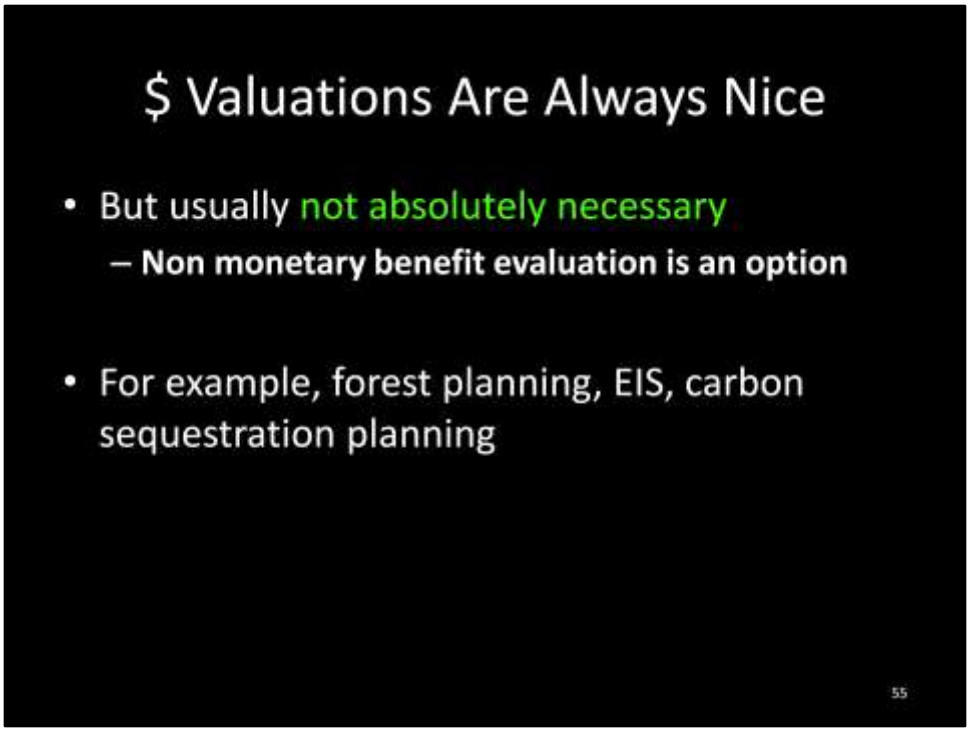


- This paper gets into more specific examples of how we can apply economic valuation. It is available at http://www.rff.org/Publications/Pages/PublicationDetails.aspx?PublicationID=21513

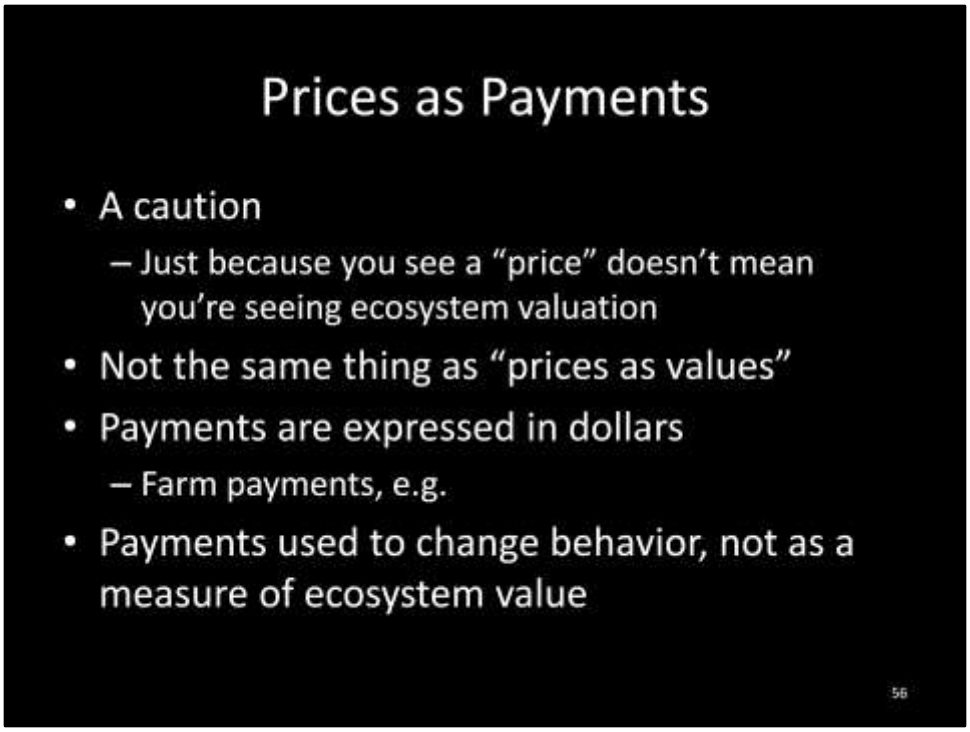
- Good news: The laws and policy are ready; they are not the constraint.
- Bad news: The greatest challenge is how to deliver the information and bring the best science to bear in ways that are useful to policy implementation. Also challenging, is the ability to deliver analysis (biophysical and economic).



- Office of Management and Budget is asking that all departments monetize regulations and potential benefits. Can be quantified if not monetized.

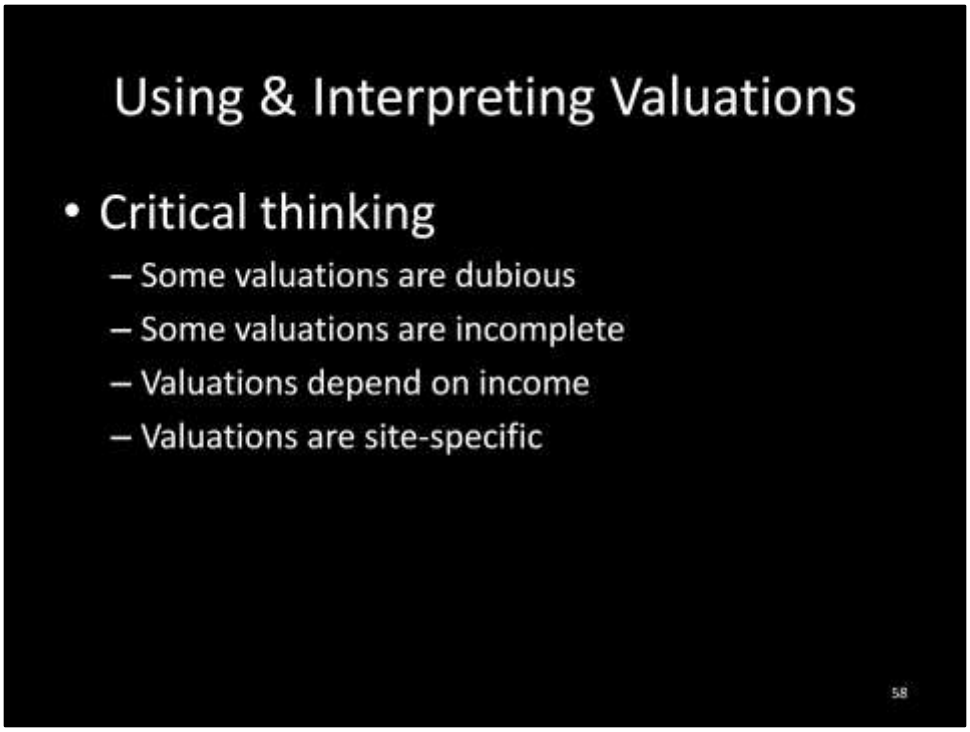


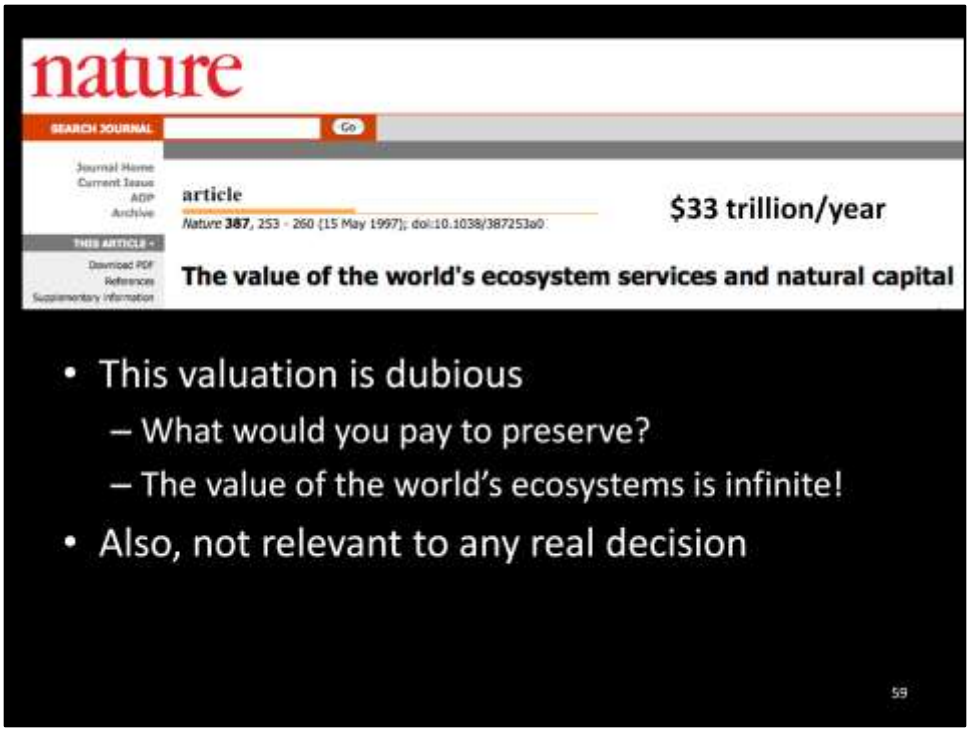
- Reminder: Dollar values are not always necessary in this.



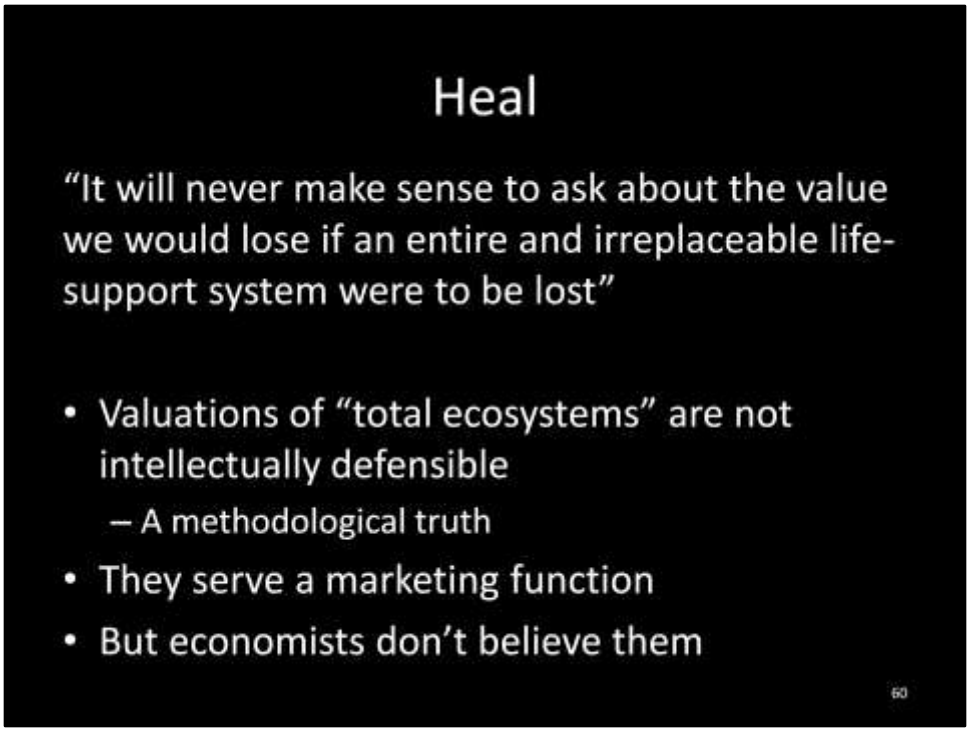
- You might see a price, but remember that it does not always indicate value.

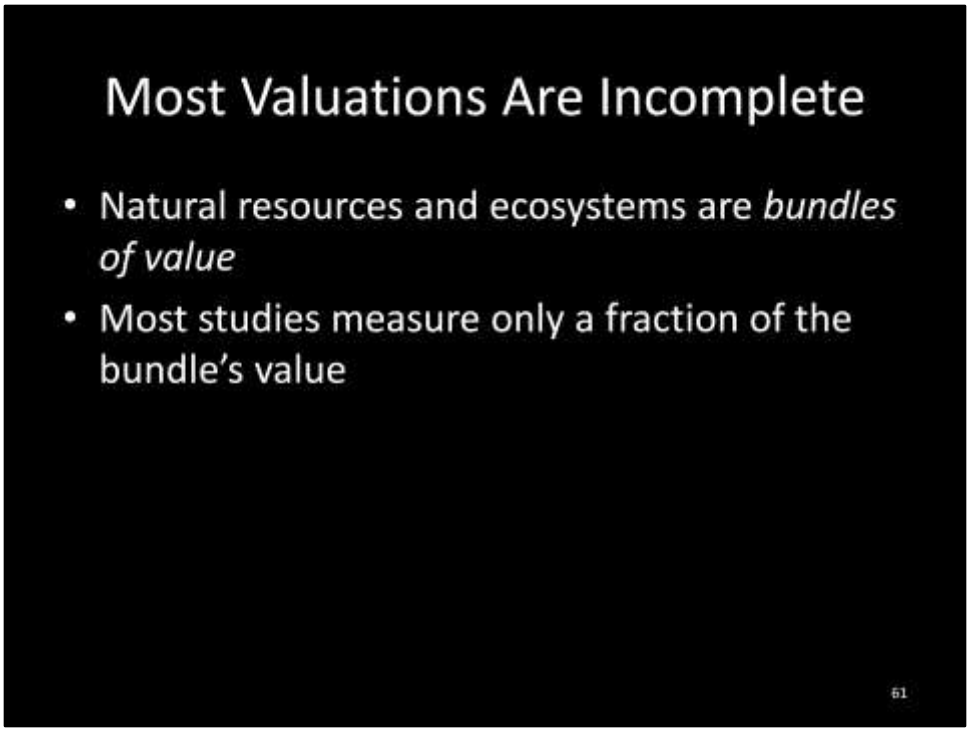

Prices From Environmental Markets
• Cap and trade, mitigation rules
– A price *emerges* from the market, it is not calculated in advance
– The price doesn't reflect ecological benefits
– Reflects benefits of reallocated control activity
57


Using & Interpreting Valuations
• Critical thinking
– Some valuations are dubious
– Some valuations are incomplete
– Valuations depend on income
– Valuations are site-specific
58

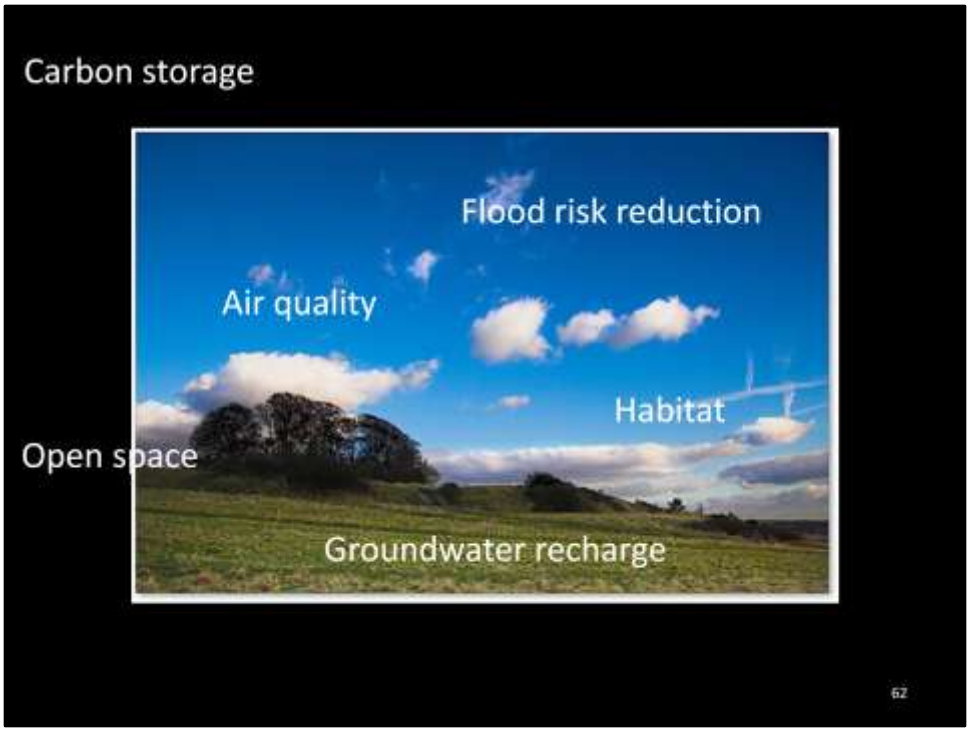


- This is the headline form the famous study by Constanza et al.
- The study was very important and very influential and I love them for it, but it is totally unbelievable and drives economists nuts.
    - The value of the world's ES is infinite.
    - The study was not based on real choices or real decisions and you cannot get values without those. The way we get values is by looking at **real behavior and real choices**.
    - This is more evocative and not relevant to realistic choice.

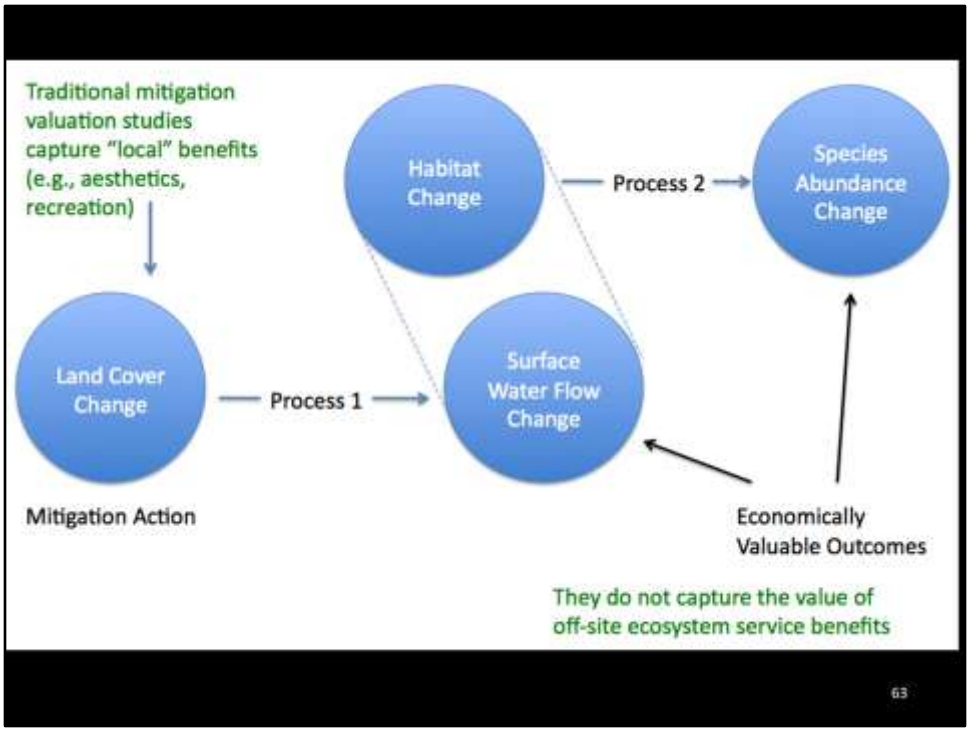

Heal
"It will never make sense to ask about the value we would lose if an entire and irreplaceable life-support system were to be lost"
• Valuations of "total ecosystems" are not intellectually defensible
– A methodological truth
• They serve a marketing function
• But economists don't believe them
60

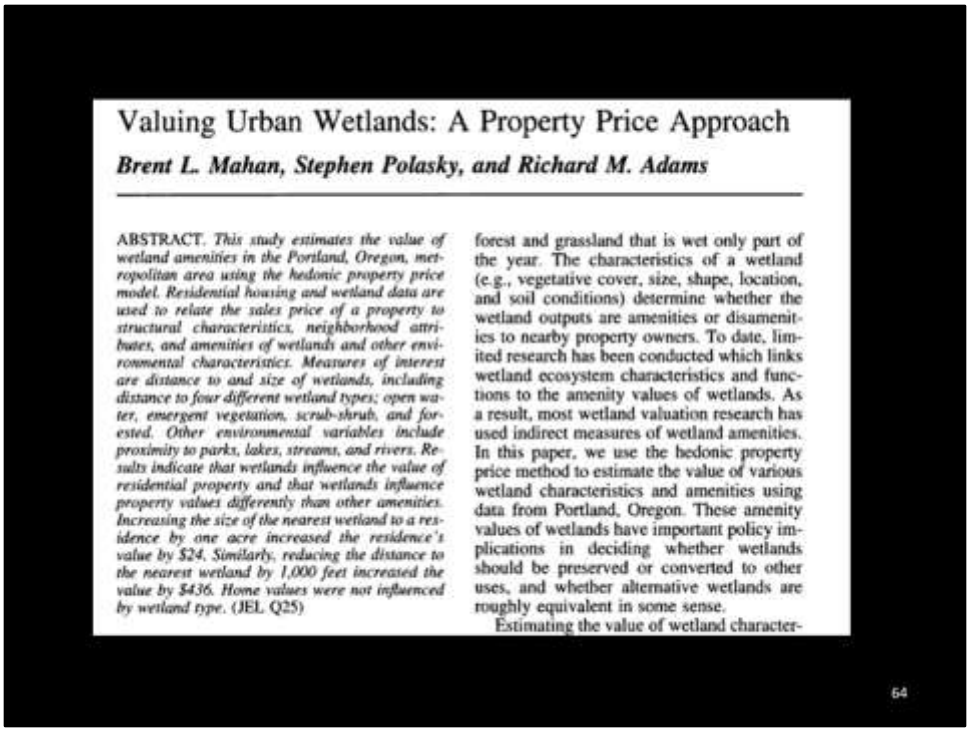


- This is very important. A criticism of academia: Most valuations are incomplete and should thus be taken with a grain of salt.



- In this landscape, there is a bundle of valuable stuff. Because of the methods we use, we do our study with the data we have and we measure only one or two of these things NOT all of them, thus the valuation is incomplete.


Traditional mitigation valuation studies capture "local" benefits (e.g., aesthetics, recreation)
Habitat Change
Process 2
Species Abundance Change
Land Cover Change
Process 1
Surface Water Flow Change
Mitigation Action
Economically Valuable Outcomes
They do not capture the value of off-site ecosystem service benefits
63



Valuing Urban Wetlands: A Property Price Approach

Brent L. Mahan, Stephen Polasky, and Richard M. Adams

ABSTRACT. *This study estimates the value of wetland amenities in the Portland, Oregon, metropolitan area using the hedonic property price model. Residential housing and wetland data are used to relate the sales price of a property to structural characteristics, neighborhood attributes, and amenities of wetlands and other environmental characteristics. Measures of interest are distance to and size of wetlands, including distance to four different wetland types; open water, emergent vegetation, scrub-shrub, and forested. Other environmental variables include proximity to parks, lakes, streams, and rivers. Results indicate that wetlands influence the value of residential property and that wetlands influence property values differently than other amenities. Increasing the size of the nearest wetland to a residence by one acre increased the residence's value by $24. Similarly, reducing the distance to the nearest wetland by 1,000 feet increased the value by $436. Home values were not influenced by wetland type.* (JEL Q25)

forest and grassland that is wet only part of the year. The characteristics of a wetland (e.g., vegetative cover, size, shape, location, and soil conditions) determine whether the wetland outputs are amenities or disamenities to nearby property owners. To date, limited research has been conducted which links wetland ecosystem characteristics and functions to the amenity values of wetlands. As a result, most wetland valuation research has used indirect measures of wetland amenities. In this paper, we use the hedonic property price method to estimate the value of various wetland characteristics and amenities using data from Portland, Oregon. These amenity values of wetlands have important policy implications in deciding whether wetlands should be preserved or converted to other uses, and whether alternative wetlands are roughly equivalent in some sense.

Estimating the value of wetland character-

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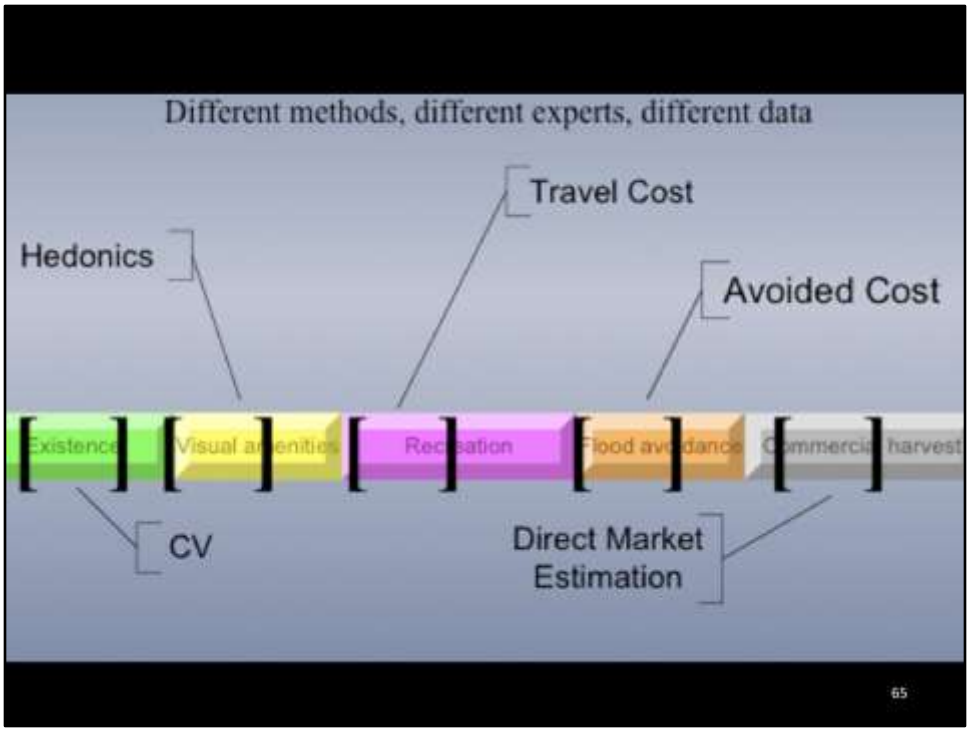
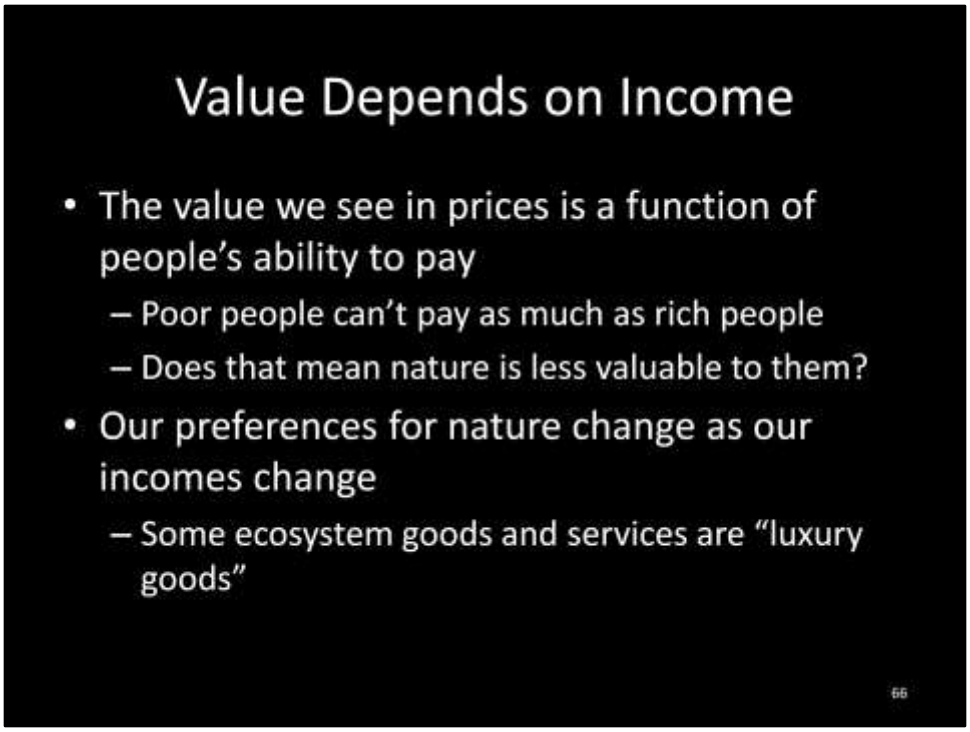
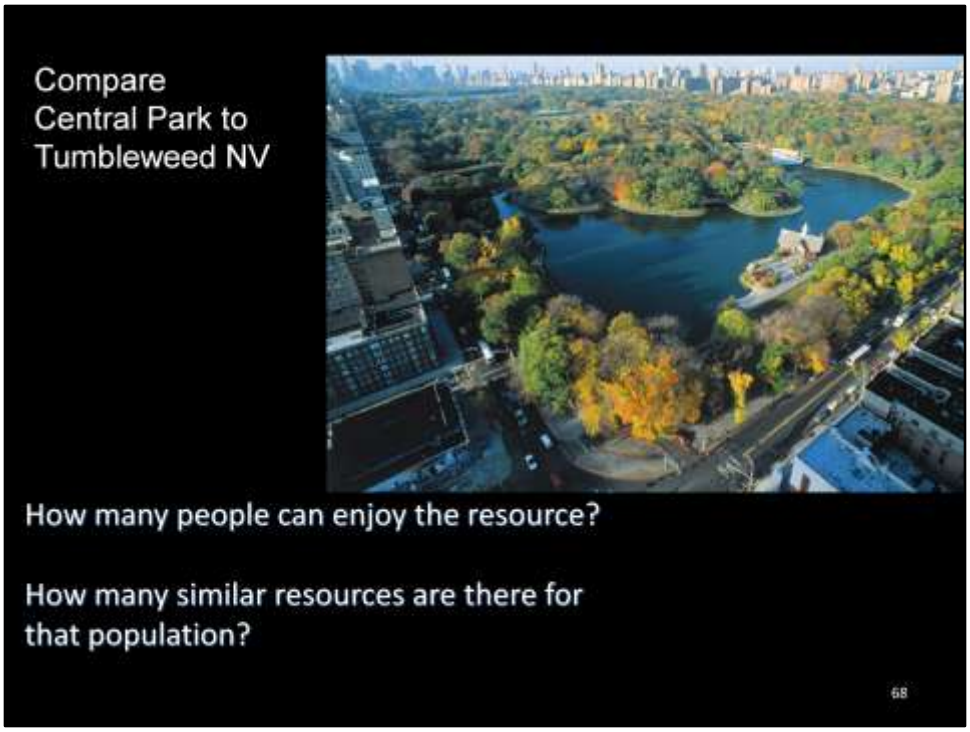
- Here is an example of a study that showed that houses are more valuable when near a wetland. You need to read the evaluation carefully to recognize that it utilized a very narrow scope for the evaluation. The authors discuss this fact extremely well in the paper, but you have to read thoughtfully to get it.
- The lesson here is to read the studies knowing that the science is limited. The authors know this and sometimes it is hard to convey and hard for non-economist readers to understand.


Different methods, different experts, different data
Travel Cost
Hedonics
Avoided Cost
Existence
Visual amenities
Recreation
Flood avoidance
Commercial harvest
CV
Direct Market Estimation
65

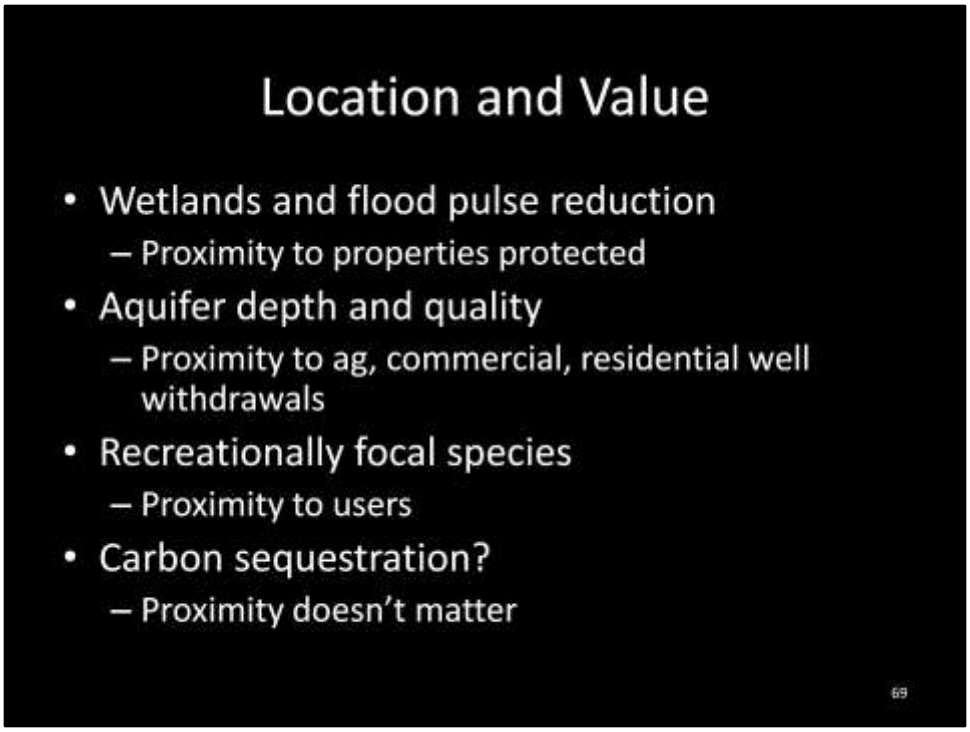


- Another danger is that valuation totally depends on income.
- How much you have to spend in general dictates how much you are willing to spend on nature.
- Value is contingent on these disparities of income.

- Ecosystem services values are almost totally dependent on location. This is partially due to the nature of the system's ecology. Just like your house, the value is based on where it is and it proximity to schools, parks etc.



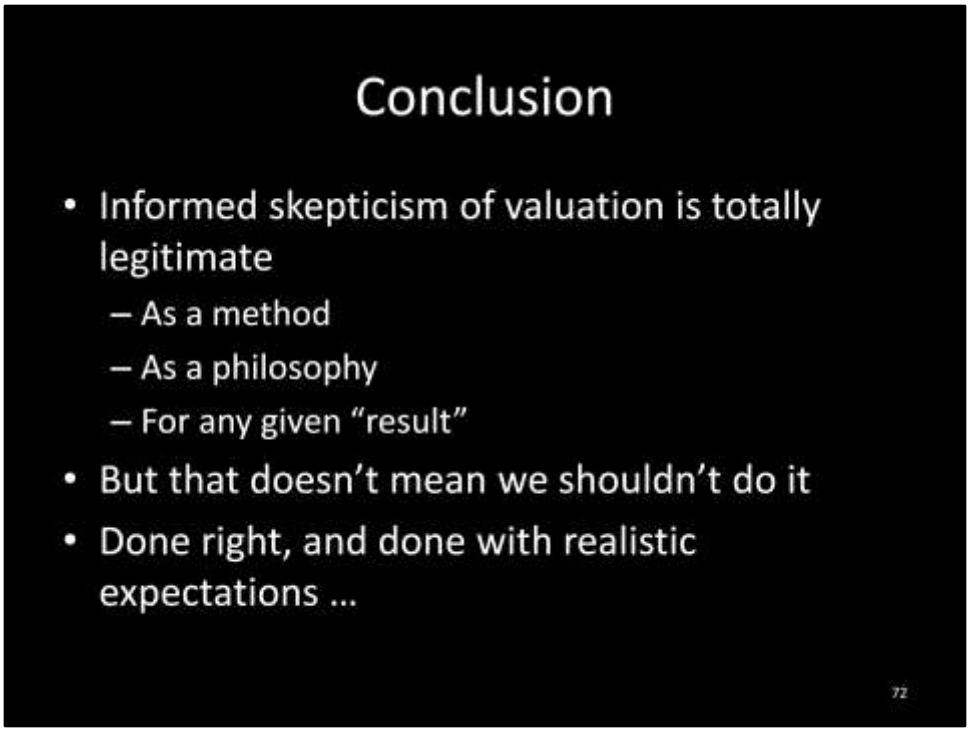
- Central Park is probably not that ecologically important but it is very valuable because of its location. It is the only green-space resource for many people. It is a diamond!
- A biophysically equivalent space in Nevada would be worth much less, because people around it would value it differently.


Location and Value
• Wetlands and flood pulse reduction
– Proximity to properties protected
• Aquifer depth and quality
– Proximity to ag, commercial, residential well withdrawals
• Recreationally focal species
– Proximity to users
• Carbon sequestration?
– Proximity doesn't matter
69

- The more substitutes that exist, the less scarce your resource is.
- Co-locations with other resources is important. There are other amenities that can enhance the experience

To conclude:

- There is great receptivity between ecology and economics right now. I remember when it was not so and now the world around us wants ecology and economics to work together and it is happening.
- Conservation Measures (CMP) and Results Based Management (RBM) are looking to quantify and evaluate outcomes of conservation. There has been tremendous progress in that realm.
- Wealth Accounting and the Valuation of Ecosystem Services (WAVES) is working to improve the kind of information available to decision makers on a national scale, so that they may better make development decisions.



- If you feel skeptical, that is okay.
- I hope I have convinced you that we should do it anyway. If we acknowledge what is wrong with valuation, we can move forward with realistic expectations.

Valuation

- Communicates an important truth
  - Nature is valuable
- Complements purely biophysical messages
- Underscores breadth of nature's social benefits
  - From the sacred to the mundane
- Reaches and can influence important audiences

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Seminar 3 Discussion Synthesis

May 31, 2011

This document is a synthesis of important topics and questions discussed during the question and answer period immediately following Dr. James Boyd's presentation. Please keep in the mind that the following is only a recap and speaker identities have been removed, except for Dr. Boyd. We hope that the following notes and discussion questions will be used as resource to advance further discussions about ecosystem services.

Below you will find a summary of specific key questions and topics that were covered during the Seminar discussion.

Question 1

One thing I have noticed when dabbling with monetary and non-monetary valuation is that large numbers can be hard to grasp. A disconnect exists between large numbers and bundled values as well as between the tangible and intangible values. Is there an answer to help build the connection? Would a local scale suffice?

DR. BOYD

- Big numbers function in a very different way. I think of them as a tool of the popular media to connect with an audience that is not actually making decisions on the subject at hand. The numbers are usually just a component to influence the popular audience.
- I do think that working from the household level to get at valuation is important and is something I would like to pursue. We should reach out to people and educate them as well as get them to educate us. When you work at the household level, you encourage this and by listening, we learn a lot about why people value nature.
- We tend to fill the vacuum with our own thoughts about why we think nature is valuable while we have a lot to learn about why other people think it is valuable. We may not necessarily like the answer, but it is an answer nonetheless and therefore valuable.
- When you provide a huge number, it does not really help beyond describing a limited picture. I would say that by working from the household level, we would get a stronger understanding of valuation and build a more descriptive scenario. From there we can scale up to the country, state, and national levels (however, we must be careful about how this is done). Once you have a strong understanding of how and why people value nature, you can begin to use numbers again.

Question 2

Do you have guidelines or can you recommend a handy rubric for when you should trust an economist's valuation? I am thinking about how information is presented. For example, I may not care if something is worth US $2 million, but I will care if it will save the lives of 300 children. If you are trying to develop a compelling analogy, how do you know what to listen to and what is a fuzzy analogy?

DR. BOYD

- You bring up an interesting point. The application you are talking about is a good one and one I have thought about doing but never have. Another black box we deal with is how much we spend on the military. For instance, if we talked about our daily fuel bill in Afghanistan in terms of what else we could buy with that money it would be a powerful communications device. I think using analogies is a really good strategy and one we do not do enough.
- In terms of when to trust an economist, I think you can test them and see how they react. Generally, I would shy away from those that appear more confident in their answer. In the presentation, we discussed how many valuation studies are incomplete and economists know this. The more comfortable an economist is with you asking questions and poking him/her indicates to me that they are more trustworthy. If however, they react in a defensive way, I would not trust the valuation.

Question 3

What are your thoughts or opinions on the Natural Capital Project InVEST?

DR. BOYD

- First off, it is important to emphasize that InVEST is developing tools that are meant to be used. They are more involved in the biophysical element than actual valuation and they are creating the foundation on which valuation is built. They have various levels in development: a water quality module, a carbon module, etc. They have a nice tiered mindset. Tier 1 would not satisfy the scientist, but it is good to discuss with the public. Tiers 2 and 3 are more nuanced and technical.
- One thing I would say is that we need to be extremely sympathetic to their challenge. They are working in a data poor environments and they are trying to create a set of tools that will be broadly applicable. All in all, I would like to give them a hug to thank them for what they are doing.

Question 4

In your chapter, you talk about two themes: 1) the difficulty in measuring resilience and 2) the importance of ecological endpoints. Could you not also say that some ecological endpoints act as indicators of resilience?

DR. BOYD

- The endpoint idea is to get the ecology and economics to synchronize together. Imagine being an economist and you have to figure out what the ecological outcomes actually mean and describe it in a way that makes sense to the public. I call it the neighbor test. If you talk to your neighbor about improvements in water salinity, will they know what you are talking about? Probably not. You still have to translate those things that we measure into outcomes your neighbor will understand. People tend to understand abundance and the availability of water, i.e., can I go swimming and not get a rash?
- A dark secret of interdisciplinary work is that if you cannot make that connection, you cannot pass the baton very well (e.g., the social scientists must attempt to make the connections themselves). The end point idea is to find a way to do this properly and push the ecologists and economists to get as close to something your neighbor can understand as possible. In the last couple of years, I have been working with a couple of ecologists trying to do this. I am working with the U.S. Environmental Protection Agency (EPA) to examine what we currently monitor to see what social and economic inferences can be made from what information we already have. We are also asking what else we would have to measure to get this sort of information.
- Resilience is a function of connections on an aggregate scale not just little pieces we destroy or degrade. We cannot get caught in micro data; we need macro data and need to plan for this. How do we create resilience given that all this change is coming from climate and demographic pressures? Again, this is the future direction.
- In economics, resilience has its own definition. There are a lot of core commonalities between economics and ecology in this regard and again, it is a place where economics and ecology can really work together.

PARTICIPANT

- It seems that there is an assumption that economists have a way to look at the whole and ecologists are looking at the pieces. We should take care not to think of fiscal and ecological disciplines. The two should evolve together to become more nuanced and complex.

DR. BOYD

- That is a really good point. The National Center for Ecological Analysis and Synthesis (NCEAS), at U.C. Santa Barbara, was created to do what you just mentioned. There is going to be a new synthesis center that will focus on bridging the social and natural component in Annapolis, Maryland. Resources for the Future (RFF) and I are involved in getting it going. The National Science Foundation (NSF) is participating in this too, so it is at that level.

Question 5

Talking about benefit indicators, I focus on cultural ecosystem services and would like to know what you think about those values that it is tough to put a number on? How do you address that? Do you count the number of people who feel connected to the wetland? Or is there a value for spiritual connection?

DR. BOYD

- I think there is a role for valuing cultural services but you need to be careful that you do not go too far. If you can show that there is a community and identify that the community is spiritually connected to a particular site, then it could be helpful to say there are a thousand of such people. You could then use the total number of people as your valuation.
- I would not go further than that and say how spiritually important the wetland is. Then you can get into trouble. But yes, it is important to remind people that places hold spiritual significance and there are X amount of people who have this connection.
- Also interesting to think about the "awe" aspect. One could work with a psychologist to determine what triggers "awe" to figure out if it can be quantified. For example, depth of field could be a factor that creates "awe." Perhaps the bigger the viewshed leads to a bigger depth of field that leads to a greater experience. This may be one crude way to compare Illinois to Wyoming. Then can calculate visitation, i.e. how many people see and experience that "awe." I know I am grasping here a little bit.

Question 6

Can you give a few examples in the United States where there is demand for this kind of information? How comfortable are you with supplying this type of data?

DR. BOYD

- There is a lot of demand for this kind of information but the lack of high quality data is a part of the issue. You need teams to work on this sort of thing. One of the fallacies is that you can bring in one economist and they can package up all the information how you need it. The problem is that you need an ecologist and an economist working together. Usually the needs are place-based and stakeholders will be involved as well. This is what is holding us back.
- We can talk about the Catskills example, but a lot of things fell in to place for that to happen and be successful. We are all strapped for budgets and for time. Depending on what you are looking for, i.e. if you want something scientifically credible, it is hard to pull off in a cost effective and quick way.
- It does take investment. The U.S. Geological Survey (USGS) for example has created a new office and they have hired an environmental economist. The Nature Conservancy (TNC) has hired an environmental economist. Often one person is hired and they are asked to weigh in on a bunch of stuff. We are contrasting with biophysical, social, and economic aspects of things. Getting real numbers is the hurdle right now.

Question 7

In Heal's paper ("Valuing Ecosystem Services." Ecosystems 3:1 (Jan.-Feb., 2000): 24-30.) he seems to argue that economics must provide the institutions with a method. Can you speak to that?

DR. BOYD

- He is making a really important point. For many people and organizations, the way you should think about price is as the carrot or stick to changing behavior. Again, the farm bill, we will pay $X per acre if they implement crop rotation or participate in activities that preserve nutrients in the soil. That price or incentive is not the value of what we get from those particular actions, it is just the behavioral tool used to get the change. Do you need the actual value? No.
- Heal is making the point that price in economics is about making behavior change in the way you want it.

Question 8

Did this lecture make you more comfortable with economic valuation of ecosystem services or less? Why?

PARTICIPANT

- The monetization makes me uncomfortable for many situations, but potentially quantifying does not.

PARTICIPANT

- I am struggling with this theme of monetization and non-monetization. I spent 6 years working on the Colorado River ecosystem and we had to work with the Native American valuation of that resource versus that of ecologists. I am not sure monetizing or not monetizing gets you past the challenge of comparing the resource value to have a discussion. Ecologists would describe the health of the landscape in ecologic terms while the Native American elders would give us a value without telling us why. In the end, we could not get them to have a discussion together and we were always in a stalemate. We need to have a common currency so we are able to examine tradeoffs. I think non-monetization is a cop-out because we need to get to a common currency.

PARTICIPANT

- There is a problem with the service provider and service recipient framework. Some cultures do not think in these terms so it is quite difficult to interpret valuation is this way. Even attempting to may be offensive to some people. Some cultures have kinship relationship and I am at a loss as to how to value that. How do you work with that?

PARTICIPANT

- I have been struggling with these questions for years; it is really an existential problem. As conservation economists, we have to play both sides because the science does not get us there, not even close. In the ideal world, you get things into the right currency and can perform a cost-benefit analysis. This is a systemic challenge and I am conflicted.

PARTICIPANT

- The decisions are being made. By not assigning a value, the system will implicitly value it at zero, which is much worse.

PARTICIPANT:

- I have a background in economics and I am in the process of using it for a policy valuation. I am frustrated because economic valuation is one tool. A colleague of mine said it best when he reminded me that no one marched on Washington D.C. because of a number. Valuation can help evaluate tradeoffs but it depends on what you are trying to accomplish.

PARTICIPANT

- I do not know if I am more or less comfortable with it. I spend a lot of time thinking with economists and working with engineers. What I find interesting is coming up with a nontraditional mechanism.

Question 9

One thing you said is that there is a great appetite and a willingness to undertake this work in federal agencies and in corporate settings. What we did not get from you is a tidy package or set of references for where to turn in our specific areas. Just speaking from a philanthropic point of view, where do critical things need to be developed for which government is not willing to pay? Or do you not have an answer?

DR. BOYD

- This answer is not going to do that question justice. In a generic sense, the thing that does not occur enough is cross-collaboration. Scientists are in their own world: the EPA has 300 ecologists in their office and they are all by themselves. Another example: I have held workshops and tried to motivate those scientists to talk to people in program offices with decision-making authority, but it does not happen. And it is the most obvious thing in the world to do.
- Point 1 is to facilitate and to get the science agendas to be sensitive to, motivated by, and in constant conversation with the users who can make changes on the ground. Again, it sounds obvious but it does not happen.
- Another thing that inevitably follows from that is working through the philosophical and language complications so we all understand what the focus is and work together. Have to do interdisciplinary studies along with cultural building to foster collaborative work.
- Another thing I would say is that government is not particularly well set–up to start working with ecosystem services valuation. Government rarely focuses at the right scale for ecosystem services valuation. We need more Catskill watersheds and the kind of focus that demonstrate how all these things come together. Getting to the right scale has been a problem and is an area with which philanthropic organizations can help.

- Economists need help moving away from the obsession of being published. This is what 99% of my colleagues care about. Economists should be worried about the quantity or quality that is changing, but it is really all over the map. As economists, we need to clarify and make it more consistent.

Question 10

How much impact can the ecosystem services movement have without explicit social valuation? Without dollar-based outcomes?

DR. BOYD

- Let me try to explain the question. As an economist, I see development within academic ecology/ natural sciences like the Natural Capital Project/InVEST–it is responsive and much more managerial and interactive; this is not just science for scientists. I wanted to trigger some discussion on whether what is happening in ecology is important just on its own.

PARTICIPANT

- One very interesting thing I have noticed today is how many different audiences we have come up with and the needs and frames of reference of those audiences. Also, there are various uses for ecosystem services. Some user groups I have noticed include popular media, corporate industry, policy makers, community members, and NGOs. Some of these groups will prefer monetary valuation while others will prefer more qualitative valuation. It is the classic economist answer: "it depends."

PARTICIPANT

- It gives you the opportunity to be adaptive.

PARTICIPANT

- We are narrowing the economist and end-user definitions. Defining what you really want might be more valuable. Maybe at the household level and then see the commonality.

DR. BOYD

- Another thing that was in the back of my mind in this question: I opened Newsweek or Time magazine shortly after Hurricane Katrina and there was an incredible picture and description on how wetlands buffer storm surges. First, there was action at a distance and then there was a lot of learning about biophysical cause and effect. I see our culture learning a lot. Our culture is learning a lot about climate change too. The fuel we burn here is affecting Madagascar. We are seeing systems that are connected in a way we have not seen before and that in itself has real value.

PARTICIPANT

- We have talked about local context and why it is important, but we have also talked a great deal about increasing scale. How do you reconcile that?

DR. BOYD

- I know many valuations are place-based but we do not have enough people; we are already being pulled in many different directions and the money is too thin. There is too much demand and we do not have incentives. When I say scale, I mean scale in terms of getting all parts working together as opposed to a large geographic scale.

PARTICIPANT

- I agree. There are not enough people or bodies working to get this together. There is cool funding available. For example, there are funding programs to support PhDs and masters programs for students from developing countries. This is a good example of how to scale up impact.

PARTICIPANT

- Do you need to put a value on social values or will that just come through via the stakeholder process? Everyone comes to the table with skepticism, but it still goes through the process.

DR. BOYD

- It can come through in the stakeholder process and you do not have to get the experts to do it. Getting stakeholders involved will create more buy in etc., but it can be expensive too.

PARTICIPANT

- Most planning and decision processes were developed before we got to this knowledge base. Now when you have a company in business for 50 or 100 years, we cannot give the same discount rates. For instance, the marine space used to be treated by businesses and governments as a frontier. Now we are looking for new emerging uses in a limited space. We have new tools but we are still stuck in old decision-making processes.

DR. BOYD

- I painted this positive picture. Let us talk about government first. Even if you look at our laws, they pretty much permit if do not actually explicitly call for ecosystem service valuation. It is hard to argue with this paradigm. Our laws are about replacing things that we value that have been destroyed. At that level, we are not thinking outside the box. Tort System. JB Ruhl has written a book, The Law and Policy of Ecosystem Services, about how this has started to play out in court cases. It is not the law that is the barrier; it is actually how you come up with damages and awards. Furthermore, departments are overwhelmed everywhere. Department of Defense, Department of Transportation, they are all interested in this. They want to calculate their dependence on water resources and their footprint. That is a positive spin.
- Having said that, ecosystem services do bring up our highly fragmented jurisdictional approach to the environment. Ecosystem services require that you cross boundaries. We have a project, a fabulous success story, in which Leonard Shabman and I were working with World Wildlife Fund to create a payment for ecosystems program in Florida to get ranchers to store water on their land so that Lake Okeechobee would not overflow and therefore stay relatively healthy. The problem was that the federal agencies were not very cooperative; they slowed the program and the program had to deal with each element separately. We need to work on how we integrate and manage jurisdictions.

PARTICIPANT

- Yeah you touched on it: most of our decision-making is piece meal. It is important to get the language right to get people to talk about the same thing. We are facing this everywhere.

DR. BOYD

- Other countries do a much better job; Britain has a planning culture we do not have.

PARTICIPANT

- There is already a challenge to think about bringing ecology and economics together in a meaningful way. There are many ways to get at valuation and non-monetization. What about polling people in a stakeholder process? It is possible to poll them pre and post to understand their knowledge so we can actually document the change from point A to point B.
- The Catskills example gets used repeatedly and it would be great to have another holistic example that engages all people and agencies to cookbook the process and document it in a valuable way.

PARTICIPANT

- On getting to a shared language, the mental gymnastics themselves can have an impact. Just by asking the questions, you might create a new form of thought. Some resist it but some jump on board and then frame thoughts in that way.

PARTICIPANT

- If you were to ask a question in a survey, what would you ask?

DR. BOYD

- We all know how horrible the “ecosystem services” language is. “Ecological wealth” might be slightly better but even this is poor. Basically, you want to know how people actually perceive their environment and how they perceive and interact with nature. The way to do it might be to look at activities and try to deduce the relationship that way. It is a deep question. Scientists who deal with this are all over the place.

PARTICIPANT

- So now, I wonder if we should ask people at all. Government makes decisions and we provide a proxy but we are never really asked if we like how much we spend on healthcare, or on defense etc. We elect people to represent us, but we are never directly asked, so maybe we do not need to ask for environmental valuation.
- One thing I am starting to recognize is that if we are really going to take this ecosystem services concept to heart, we are going to have to change ourselves. We will have to move from a conservationist view (which has really been a preservationist view) to a sustainability view. We maybe need to tell the sustainability story in this frame.

Seminar

4

Policy and Management Tools for Ecosystem Services

Speaker

Pavan Sukhdev

GORDON AND BETTY MOORE FOUNDATION

Policy and Management Tools for Ecosystem Services

by Pavan Sukhdev GIST Advisory and United nations Environmental Programme's Green Economy Initiative (formerly)

INTRODUCTION

The living fabric of this planet — its ecosystems and biodiversity — is in rapid decline worldwide. This palpable degradation is the result of a combination of human activities such as commercial overexploitation, population pressure, and ill-informed policies. At a very fundamental human level, however, it is due to the lack of awareness that there is a problem with human society's disconnection from nature.

Economics is blamed for many of our woes these days and credited with little. This popular sentiment begs the question as to whether our perspective on economics is part of the problem of ecosystem degradation and biodiversity loss. The answer to this is a fairly obvious "yes."

The economic invisibility of nature in our dominant economic model is both a symptom and a root cause of the problem. We value what we price, but nature's services — providing clean air, fresh water, soil fertility, flood prevention, drought control, climate stability, etc. — are almost never traded in any of our markets and as a result are not priced. These ecosystem services, which are all freely available public goods, are given a back seat by our tendency to value private wealth creation over improving public wealth. As a result, creating a healthier natural world does not seem to be a priority on the economic agenda.

THE ECONOMIC INVISIBILITY OF NATURE

Water is the most important natural resource, but it is an invisible part of nature because its benefits are not proportionately recognized. While numerous studies have highlighted the climate change mitigation services provided by tropical rainforests (Eliasch 2008; Lewis and White 2009; Trumper et al. 2009), few account for the water losses associated with deforestation. The Amazon rainforest "water pump" is believed to return 20 billion metric tons of water into the atmosphere through evapotranspiration, some of which falls as rain over the Rio Plata Basin, the granary of Latin America (Marengo et al. 2004). The agricultural economy of Latin America, which is estimated to be worth US $240 billion (World Bank 2009), is dependent on this water. Despite this dependence, the value is never accounted for in the valuation process, owing to the economic invisibility of water.

Another aspect of the economic invisibility of nature has to do with the poor and their relationship with nature. When dealing with poverty, an important question to ask is: how do we manage the risk to the poor associated with losing nature? Coral reefs demonstrate this issue well. Huge coral bleaching events have already occurred, and their rate is likely to increase in the future. These reefs provide food and employment to nearly 500 million people (Wilkinson 2004), or about 8% of the world's population, who live primarily in less developed countries and whose economic and social well-being is directly tied to the ecological health of the reef. This makes the health of coral reefs not only a biodiversity issue, but also a people issue. There is a need for better understanding and appreciation of the natural and human impacts resulting from this loss. We need to understand the poverty dimension. Societies in the developed world will be impacted to some extent by coral reef bleaching, but not nearly as much as those societies whose residents depend on the reefs for their livelihoods.

To help illustrate the invisibility of ecosystem services, Figure 8 below summarizes the findings of a study conducted in Thailand in 2001 and 2007 (Barbier 2007), which observed a loss of mangrove forests due to the conversion of mangroves to shrimp aquaculture. This conversion has a huge economic discrepancy in the form of subsidies that incentivize shrimp aquaculture. Without these subsidies, the conversion of mangroves to shrimp aquaculture is far less attractive, delivering only a slight economic advantage.

Furthermore, if one were to account for the ecosystem services affected and make them visible, the benefits would change substantially. Not only is there an immediate loss of area in mangrove ecosystems, but overall fertility decreases after just a few years under shrimp agriculture. The decrease is so extreme that shrimp farming can no longer continue. In the end, mangroves, which provide additional public wealth benefits to local villages, such as storm and surge protection, and act as fish nurseries, are converted to produce only a few

years of immediate private profits from shrimp aquaculture. A completely different tradeoff diagram results when such public wealth factors are included.

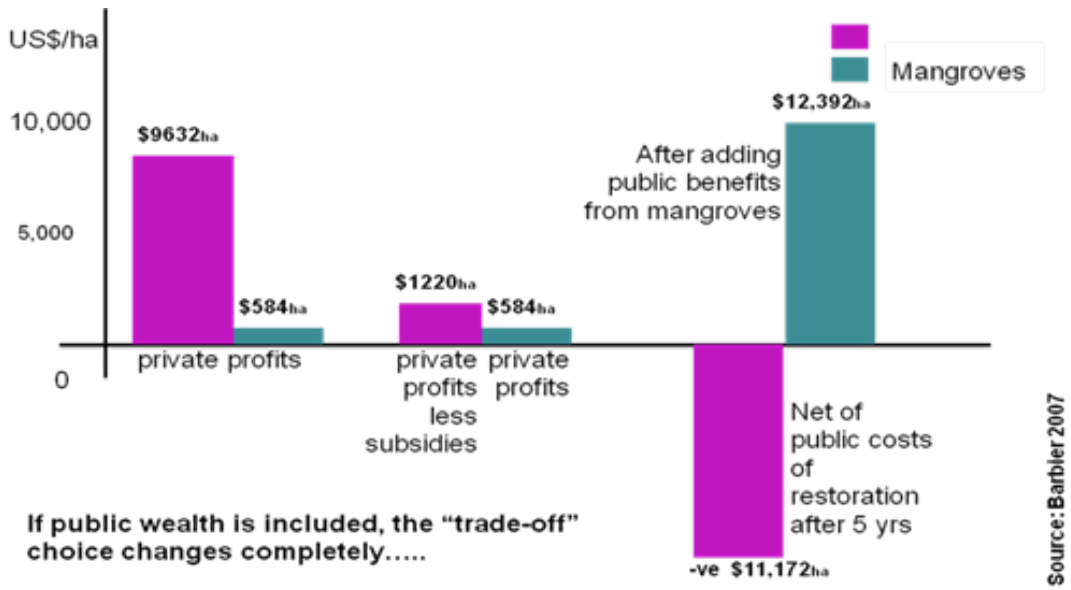

Figure 8: Private Profits, Public Losses: Shrimp Farming, South Thailand.

The story of shrimp farming in Thailand is not unique; all over the world, private profits trump public wealth. A United Nations Principles for Responsible Investment (UNPRI) study that examined a database of the top 3,000 publicly listed companies in the world estimated that the cost of "business as usual" practices was US$2.15 trillion (UNPRI and UNEP FI 2010). This represents 7% of their combined revenues and 35% of total global environmental costs. Although none of the practices cited are illegal, they are an indication of the way business is conducted today.

THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY

In 2007, amid findings such as the ones presented above, environment ministers from the governments of the G8+5 countries meeting in Potsdam, Germany, agreed to "initiate the process of analyzing the global economic benefit of biological diversity, the costs of the loss of biodiversity and the failure to take protective measures versus the costs of effective conservation" (TEEB 2010b). The Economics of Ecosystems and Biodiversity **(**TEEB) project, which emerged from that decision, has delivered a series of reports addressing the needs of major user groups: national and local decision-makers, businesses, and the wider public.

"The aim of TEEB is to provide a bridge between the multi-disciplinary science of biodiversity and the arena of international and national policy, as well as local government and business practices. The scope of TEEB is intentionally broad and it should therefore be seen as an inspiration, and as an invitation, for others to deepen its findings and to develop more context specific recommendations. Ideally, TEEB will act as a catalyst to help accelerate the development of a new economy: one in which the values of natural capital, and the ecosystem services which this capital supplies, are fully reflected in the mainstream of public and private decision-making." (TEEB 2010b)

Applying economic thinking to the use of biodiversity and ecosystem services can help clarify two critical points: why prosperity and poverty reduction depend on maintaining the flow of benefits from ecosystems, and why successful environmental protection needs to be grounded in sound economics, including explicit recognition, efficient allocation, and fair distribution of the costs and benefits of conservation and sustainable use of natural resources.

The values of nature vary according to local biophysical and ecological circumstances and the social, economic, and cultural context. Intangible values, which may be reflected in society's willingness to pay to conserve particular species or landscapes, or to protect common resources, must be considered alongside more tangible values, like food or timber, to provide a complete economic picture. To enable this, TEEB has come up with a set of recommendations, shown in Text Box 1.

TEEB does not use a cost-benefit approach to valuation. Instead, it recognizes valuation as a human institution, a way for society to give itself feedback. One can assign value with no use of economics whatsoever. For example, take a sacred grove. To members of the local community, that grove has plenty of value and should not be destroyed, yet they communicate the value differently, without the use of economics.

Payments can be identified for preserving values that are captured. One can pay to maintain biodiversity in order to continue harvesting products, i.e. timber, pharmaceuticals, and carbon sequestration. In this case, the purpose of ecosystem service payments is to provide compensation. The TEEB view of valuation is cautious and layered through three approaches: recognizing value, demonstrating value, and capturing value.

There have been several success stories using this approach to valuation, including a prominent one at the Tubbataha Marine Park in the Philippines. Following a large bleaching event in 1998, the community collectively decided to create no-take areas based on collective action. The highly successful legislation did not use economic valuation, but instead recognized the needs of all members of the community — both those pushing for greater conservation (e.g., divers, dive operators, non-governmental organizations [NGOs], and government agencies) and those claiming their rights to extract resources from the park (e.g., local fishermen, commercial fishing operators, and agencies governing the fishing areas). As a result, between 1998 and 2004 there was a 10% increase in live coral cover, and the availability of fish biomass increased to twice that of the average healthy reef (Matt and Gebser 2010).

KEY RECOMMENDATIONS OF TEEB

- System of national accounts: Upgrade the SNA to include changes in natural capital. Start with physical accounts for forest stocks and carbon storage.
- Business: Standardize, measure, and disclose all major "nature" externalities in statutory annual reports.
- Subsidies: Measure and annually disclose environmentally harmful subsidies, manage them down, and phase them out.
- Ecological infrastructure: Evaluate and invest in ecosystem conservation/restoration for freshwater, soil, mitigation ("Making REDD+ Real") and adaptation (TEEB climate issues update).
- Local and regional government: Build ecosystem service values into regional land plans, protected area budgeting, eco-certification, and payment for ecosystem services (PES).

***Text Box 1: Key Recommendations of TEEB**. Source: TEEB 2010b.*

Another good example of using the ecosystems approach for planning is that of the Nakivubo swamp in Kampala, Uganda. A study evaluated the cost of converting the swamp to agriculture, wherein ecosystem services provided by the swamp were estimated at US $1–1.75 million/year (Almack 2010). The cost of constructing and maintaining a new sewage plant, estimated at US $2 million/year (Emerton et al. 1999), was greater than the cost of keeping the wetland, and therefore it was decided to preserve the wetland.

The Reducing Emissions from Deforestation and Forest Degradation (REDD+) project in the Ulu Masen Ecosystem, Aceh, Indonesia, combines land-use planning and reclassification, increased monitoring and law enforcement, reforestation, restoration, and sustainable community logging on 750,000 hectares of forest in the Ulu Masen Ecosystem and peripheral forest blocks located in Aceh province. This is an ideal example of collaboration between governments, civil society, and the private sector. In this case, the provincial government was responsible for looking into compliance issues and integration with government and regulatory structures. The NGO Flora and Fauna International facilitated participatory processes for community development, spatial and land-use planning, collaborative law enforcement, and community-based forest management. The project design, development, start-up, and carbon finance were managed by the firm Carbon Conservation Ltd. Estimates suggest that this activity will reduce deforestation and save up to 3.5 million metric tons of CO_2 emissions (Rafli et al. 2007).

TEEB CASE STUDY DATABASE: SUCCESSES AND FAILURES

The TEEB Cases, a case study database, compiled in collaboration with GIST Advisory, India, and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) presents case studies of success stories and failures categorized under regional planning, participatory rural appraisal, PES, legal framework, certification, economic evaluation, and cost-effective adaptation (European Environmental Agency" 2010).[1] These case studies identify best-practice examples from different parts of the world regarding effective policy actions based on economics that have improved conservation and livelihoods. The examples selected for the case studies substantiate the point that economic values can help conserve biodiversity in various ways. Each case study provides the background of the problem, the policy uptake, an overview of what it is and how it works, which ecosystem services are considered, and how the relevant strategy can result in

[1] To access TEEB Cases, please visit http://www.teebweb.org/TEEBcases.

improving the quality of the ecosystem under consideration. Some of these success stories and failures, and the lessons learned from them, are described below.

Success Story: The Kennecott Inland Seashore Reserve, Utah, USA

Kennecott Utah Copper LLC, a subsidiary of Rio Tinto PLC, is North America's largest copper mine. In the mid-1990s, the company needed additional storage capacity for tailings and purchased an area of degraded saltpans and industrial land along the south shore of Great Salt Lake (Ten Kate et al. 2004). It was later observed that this area contained a designated wetland habitat. Great Salt Lake is an important ecological resource and home to many migratory birds. Therefore, as per U.S. laws, Kennecott was required to offset or mitigate the loss of wetlands by creating an agreed number and value of habitat units (Ten Kate et al. 2004). Since many of the habitats had deteriorated due to overgrazing, the creation of salt evaporation ponds, off-road vehicle use, and illegal waste dumping, successful mitigation required the restoration and creation of water bird habitats.

In response, Kennecott Utah Copper LLC created and now manages the Inland Sea Shorebird Reserve (ISSR) and also preserves Great Salt Lake habitats to attract migratory birds. This wetland offset project is recognized as one of the largest and most successful mitigations in the United States, resulting in the creation of 1,011 hectares of shorebird and waterfowl refuge, where approximately 150,000 migratory birds and waterfowl visit each year. The total number of bird species at the ISSR has grown from 50 in 1995 to more than 150 in 2010 (TEEB Case 2010). The outcome of this project is a net gain for biodiversity. In addition to the legally required offsets, Kennecott restored surplus land adjacent to the mitigation site. Credits from this "bank" of surplus restored land can be used by Kennecott or sold to others for wetlands mitigation in accordance with the terms of the bank agreement with the U.S. government (Brownlie 2008).

Success Story: Hiware Bazaar- A Village of Millionaires, Maharashtra, India

Hiware Bazaar presents one of the best-known examples of using a development approach based on integrated watershed management to turn a village's misfortune into an ecological and economic success. From the late 1970s to early 1990s, Hiware Bazaar, in the state of Maharashtra, was a typical semi-arid village that had run out of most of its natural assets: forests had been cut, water sources had run dry, and the land had become unproductive. The village faced an acute water crisis and its traditional water storage systems were in ruins. In 1989-1990, only 12% of the land was cultivable, and there was rampant poverty and unemployment (Singh 2010). This led to large-scale migration to cities. In addition, the village was beset by social problems such as alcohol addiction and gambling. According to a survey in 1995, 168 out of 180 families lived below the poverty line (Sangameswaran 2006; Naik 2008; Sakhuja 2008).

The turnaround happened when, under the leadership of the village head, watershed development programs were undertaken in conjunction with government-run employment generation and poverty alleviation schemes. In order to regenerate degraded village forests and catchments and to restore watershed ecosystems, the village was divided into three micro-watersheds on which contour trenching and tree plantation, contour bunding, and nala (drain) bunding were executed. The result was an increase in irrigated area from 70 hectares (in 1993) to 260 hectares (in 2006), with livestock numbers increasing from 20 (in 1998) to 340 (in 2003) (Singh 2010). Hiware Bazaar is now an icon of ecological development, called the "millionaire's village," with an average per capita income that is twice the average of the top 10% in rural village areas.

Failure: Willingness to Pay for Conservation of Asian Elephants in Colombo, Sri Lanka

Rapid population growth and decades of violent conflict have worsened one of Sri Lanka's major poverty-related rural problems: human–elephant conflict, namely crop raiding by elephants. Prevention strategies (such as watchtowers and firecrackers) in densely populated areas have not to date presented viable long-term solutions. According to many studies (Jayawardene 1998; De Silva 1998; Bandara and Tisdell 2002), the total economic value of crop and property damage caused by elephants (for the entire elephant range in Sri Lanka) is Rs (Sri Lankan rupee) 561 million per cropping season and Rs 1,121 million per annum. Every year, approximately 150 elephants and 50 to 70 humans die because of this conflict (Oswin Perera 2009), and farmers with meager resources often resort to poisoning, traps, guns, and live electric wires to counter elephant destruction.

To counter this problem, Ceylinco Insurance presented a scheme based on corporate social responsibility and willingness to pay to reduce conflict and the growing problem of crop raiding. The company proposed to add a small monetary amount to policyholders' premium payments for life and vehicle insurance. To implement the scheme, the firm created awareness about the socioeconomic and cultural benefits of elephants, with the intention of creating a market for its product. A survey was undertaken to assess both town residents' willingness to pay more for their life insurance premiums to support elephant conservation and villagers' willingness to participate in the plan. The survey showed that the willingness to pay for elephant conservation was greater than the price demanded by those affected by elephant damage. Furthermore, to "establish ownership" of the program, farmers were expected to pay a nominal annual fee of Rs 650

(less than US $6). A commission of 10% was set aside for government agencies or organizations selected by the wildlife conservation department, to compensate them for the cost of implementing the program in remote areas.

In spite of its sound ecological science and economic feasibility, the scheme failed because of the management risk associated with implementing it through a single insurer. Although it seemed to be a strong design, the project was plagued by corruption and scandal and ultimately failed. This example provides an important lesson: new products such as this are best launched on an industry-wide basis rather than relying on a single organization for implementation.

IMPLEMENTING THE TEEB APPROACH: SIX –STEP ASSESSMENT

In its report *TEEB for Local and Regional Policy Makers,* TEEB has proposed a set of steps for effectively appraising ecosystem services. The approach is not a fixed recipe, but is intended to guide policy-makers in designing their own processes. Text Box 2 summarizes the six steps, and the rest of this section uses an example to illustrate how the TEEB approach can be applied.

Example

Sumatra has abundant biodiversity; it is the only place on earth where tigers, elephants, orangutans, and rhinos all reside. Local communities rely on many ecosystem services, particularly the provision of a clean and regular water supply for drinking, hydropower, irrigation, protection from floods, droughts, forest fires, landslides, regulation of air pollution, and maintenance of fertile soils for agriculture.

SIX STEPS FOR EFFECTIVELY APPRAISING ECOSYSTEM SERVICES

1) Specify and agree on policy issues with stakeholders.
2) Identify which ecosystem services are most relevant.
3) Define the information needs and select appropriate methods.
4) Assess ecosystem services.
5) Identify and appraise policy options.
6) Assess the distributional impacts of policy options.

Text Box 2: Six Steps for Effectively Appraising Ecosystem Services*. Source: TEEB 2010c.*

STEP 1: AGREE ON THE ISSUE

In October 2008, the ten provincial governors of Sumatra and four Indonesian government ministers made a historic commitment to protect the remaining forests and critical ecosystems of Sumatra. Local land-use planning is critical for achieving this commitment. Indonesia's national spatial planning process operates on a five-year cycle. Spatial planning has been undertaken in Indonesia for many years, but has only had a legal basis for measures to enforce compliance since 2007, following the adoption of the Spatial Planning Law 26/2007 (Hudalah and Woltjer 2007). In 2010, the Indonesian government was working to design spatial plans at the provincial and district levels. Much decision-making power resides on the local scale because of decentralization. At the national level, renewed spatial planning efforts involve all relevant ministries, whereas at the provincial level, an NGO forum supports planning efforts.

STEP 2: IDENTIFY RELEVANT ECOSYSTEM SERVICES

Forest conversion, mostly for palm oil, pulp and paper plantations, and illegal logging, is causing biodiversity loss and degrading many ecosystem services. In particular, conversion of lowland deep peat forests, mostly in eastern Sumatra, is a major contributor to global carbon emissions. Existing and prospective forest concessions threaten to have even greater adverse impacts. It is commonly overlooked that forests provide a range of valuable ecosystem services beyond standing timber, such as soil conservation and water augmentation. The lack of incentives to sustain ecosystem services is one of several root causes of these problems.

STEP 3: DEFINE INFORMATION NEEDS AND CHOOSE ASSESSMENT TOOLS

InVEST, a mapping tool provides information on where ecosystem services are supplied and in what quantity — in this case, on the Sumatran landscape — and how these patterns might change under future land-use scenarios.[2] It can be overlaid with biodiversity information to see where ecosystem services and conservation priorities overlap. InVEST models are based on production functions that define how an ecosystem's structure and function affect the flows and values of ecosystem services. The models account for both service

[2] Please refer to Seminar II: Valuing Nature — Economics, Ecosystem Services, and Decision-Making for a detailed explanation of InVEST.

supply (e.g., living habitats as buffers for storm waves) and the location and activities of people who benefit from services (e.g., location of people and infrastructure potentially affected by coastal storms). Since data is often scarce, the first version of InVEST offers relatively simple models with few input requirements. These models are best suited for identifying patterns in the provision and value of ecosystem services.

STEP 4: CONDUCT THE ASSESSMENT

InVEST was used to model the quantity and location of high-quality habitat, carbon storage and sequestration, annual water yield, erosion control, and water purification under two scenarios: the Sumatra ecosystem vision of sustainable land-use as proposed in a roadmap action plan, and a business-as-usual scenario corresponding to the government's current spatial plan.

STEP 5: APPRAISE POLICY OPTIONS

Results were disseminated to government representatives from nineteen districts. Preliminary recommendations were offered on specific actions, based on the potential gains or losses in ecosystem services if the Sumatra ecosystem vision and road map were implemented. For example, based on InVEST results, recommendations were made on how to prioritize areas for forest restoration based on habitat quality and the potential for reducing erosion. Information on ecosystem services can also be used to advocate for and help implement incentive mechanisms that reward sustainable land use, such as forest carbon projects, payments for watershed services, certified forestry and agriculture, and ecotourism. InVEST results in informed discussions of forest carbon projects by identifying where carbon storage and sequestration potential is high.

STEP 6: ASSESS THE DISTRIBUTIONAL IMPACTS

An assessment of the distributional impacts of changes in ecosystem services in response to policy options must focus on both global (carbon) and local (water, erosion, etc.) ecosystem benefits. In the case of Sumatra, comparing the scenarios demonstrated the social impacts of forest conversion, but the social impact assessments of policy responses remain unclear. This illustrates that the success of InVEST depends on the people who use it.

MARKET-BASED SOLUTIONS

There are also market-based approaches to valuing ecosystem services, such as PES, an economic conservation tool that has recently gained much attention. It is believed to show a lot of promise in managing natural resources by incentivizing stakeholders to agree on behavioral changes that are more sustainable. The environmental impacts of these behavioral changes are quantified and the changes rewarded. It is an instrument where buyers and sellers voluntarily agree on a payment for the provision of a specific ecosystem service (or for an activity that is believed to ensure such provision), that would otherwise not take place (Wunder 2005).

Such market-based mechanisms are suitable for some situations but not for others. Not everything can be bought and sold in markets; only private claims can be traded in such a way. For instance, markets are not well suited to solve social problems. When it comes to public services like carbon, a monumental effort is needed to create one or two success stories. Carbon markets are associated with derivatives, which imply trading of debits and credits within a ledger system. Hence, the problems of derivative markets will also affect carbon markets. These are compounded by the risk of corruption and free ridership. Carbon markets are an attempt to create rules and develop a synthetic solution to a complex problem; the chances of success are small. What are needed are complex solutions that involve public policy and community cooperation.

There are additional opportunities for valuing ecosystem services by "fixing" and "creating" markets. Attempts are made to "fix" markets by addressing externalities through certification, such as Forest Stewardship Council (FSC) certification for timber markets and the Marine Stewardship Council (MSC) certification for fisheries markets. Similarly, in crop markets polluters can be made to pay by incorporating a charge for pollution into the value of a good. "Creating markets" involves developing new markets, such as premium credits[3] under REDD+ and biodiversity banking.

[3] Premium credits are the improvements in wildlife and social benefits provided by a carbon project. These credits can be "stripped" and sold separately in a market for biodiversity credits, offsets, and to improve corporate social responsibility (CSR).

THE WAY FORWARD

Solutions to the economic invisibility of nature exist by way of acknowledging the compelling logic for a green economy over a brown economy.[4] The behavioral changes that are needed are lacking because companies seek out resources where good governance is missing. Today's corporations are hardwired to arbitrage markets. Recognition of the exploitative nature of corporations, which seek to maximize profits instead of aligning their goals with benefits to society, is needed.

Despite the general myopia, visionary companies like PUMA are leading the way by examining their entire supply chain for impacts on carbon and freshwater based on four tiers: the manufacturing of products; outsourced processes, such as embroiders, printers, and outsole production; processing of raw material, such as leather tanneries, the chemical industry, and oil refining; and raw material production, such as cotton farming, oil, and drilling (PPR HOME and PUMA 2011). In doing so, PUMA has discovered that externalities go beyond its direct activities to the activities of its suppliers. Although most of the damages to society come from its suppliers' externalities, PUMA is still accountable because those supplies make up its products. Only when externalities are reported can people have a complete view and understanding of the products.

What PUMA has done in terms of estimating and reporting business sector externalities is echoed in the main focus areas as defined by the TEEB community:

- TEEB capacity-building in developing countries;
- Country, sectoral, and regional TEEB analysis;
- Green national accounts (Wealth Accounting and Valuation of Ecosystem Services [WAVES] — the World Bank, UNEP, and others);
- Estimating and reporting business sector externalities;
- Identifying and closing ecology and valuation knowledge gaps; and
- Communicating the issues to citizens.

Work has been done in the field of green accounting by the Green Indian States Trust in New Delhi, in the form of the Green Accounting for Indian States Project (GAISP). The project measured sustainable development at the state level in India, sourcing data only from official Indian national databases, and consistent with the United Nations' SEEA-2003 guidelines. Adherence to these guidelines and sourcing data only from official national databases (but with granularity at the state level) ensures legitimacy, fairness, and methodological consistency.

GAISP's results are available through a series of eight monographs, which adjust the official national accounts for externalities such as the non-marketed services of forests (carbon storage, biodiversity values, ecological services, and so forth), the hidden costs of agriculture, losses in freshwater quality, and depletion of sub-soil assets. Human capital externalities, namely the positive externalities of education and the negative impacts of pollution on human health, are also evaluated and adjusted for in the national accounts.[5]

However, this field is relatively new and the science is still developing. It is therefore essential to identify knowledge gaps and limitations and map them into national policies. Some of the challenges and options include:

- **Links between biodiversity, ecosystems, and resilience:** Roles of species interactions and functional diversity for ecosystem resilience are unclear.
- **Dynamics of ecosystem services:** There is a need to develop specific tools to contribute to better assessment of the spatial and temporal dynamics of service provision, especially in relation to defining who benefits, where, and to what extent.
- **Understanding the dynamics of governance and management of ecosystems and ecosystem services:** There are trade-offs and complementarities involved in the provision of bundles of ecosystem services, and it is important to understand how changes in the configuration of ecosystems affect their value.
- **Valuation methods and benefit transfer:** Since marginal values are likely to vary with ecosystem characteristics, socioeconomic characteristics of beneficiaries, and ecological context, care needs to be taken to adjust transferred values when there are important differences between study and policy sites.
- **Valuations and its context:** Valuation is often carried out in a sociocultural context; for example, a patch of forest land considered a "sacred grove" by one community may not have the same significance for another.

[4] "Green economy" refers to national governments investing in and promoting environmentally sustainable opportunities for economic growth and personal incomes. A brown economy follows the business-as-usual scenario where GDP growth is based mainly on mainstream sectors such as industry, mining, and export and import, and where sustainability is not a key criterion of a country's growth strategy.
[5] Monographs are accessible at www.gistindia.org.

- **From micro foundation to macro policy**: Most valuation exercises do not allow ecosystems and economies to impact each other simultaneously. (Source: TEEB 2010a)

The way forward from here is three-dimensional capitalism complemented by sophisticated economics. Business must lead the way and seek new rules and behaviors, which will be regulated by governments and observed, analyzed, and summarized by a new-age Adam Smith — and perhaps written up as An Inquiry into the Nature and Causes of the Three-Dimensional Wealth of Nations (Sukhdev 2011).

REFERENCES

Almack, K. (2010) mainly based on Emerton et al. (1999). *Using valuation for decision support: Saving sewage treatment costs through wetland protection in the Nakivubo wetland.* Geneva: The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org.

Bandara, R. 2010. *Willingness to pay for conservation of Asian Elephants in Sri Lanka.* Geneva: The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org.

Bandara, R., and C. Tisdell 2002. Conserving Asian elephants: Economic issues illustrated by Sri Lankan concerns. In *The economics of conserving wildlife and natural areas, C. Tisdell.*, Cheltenham, UK: Edward Elgar.

Barano T., E. McKenzie, N. Bhagabati, et al. 2010. *Integrating ecosystem services into spatial planning in Sumatra, Indonesia.* The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org. Barbier, E. B. 2007. Valuing ecosystem services as productive input. *Economic Policy* 22. (49):177–229.

Barbier, E. B. (2007) Valuing Ecosystem Services as Productive Inputs. Economic Policy 22 (49): 177-229. http://www3.interscience.wiley.com/cgi-bin/fulltext/118520552/PDFSTART.

Brownlie, S. 2008. *Kennecott Utah Copper Corporation: Mine, North America, Business and Biodiversity Offset Programme (BBOP).* An unpublished study conducted by BBOP on compensatory conservation case studies.

De Silva, M. 1998. Status and conservation of the elephant and the alleviation of man-elephant conflict in Sri Lanka. *Gajah* 19:1–24.

Eliasch, J. 2008. *Climate change: Financing global forests: The Eliasch review*. Oxford, UK: Routledge.

Emerton, L., L. Iyango, P. Luwum, and A. Malinga. 1999. *The economic value of Nakivubo urban wetland, Uganda.* Uganda National Wetlands Program, Kampala, and IUCN —The World Conservation Union, Eastern Africa Regional Office, Nairobi. .

European Environment Agency. 2010. *The environmental atlas.* http://www.eea.europa.eu/atlas.

Garfunkel, A., ed. 2010. *Universal ownership: Why environmental externalities matter to institutional investors.* UNEP Finance Initiative. http://www.unpri.org/files/6728_ES_report_environmental_externalities.pdf.

Hudalah, D., and J. Woltjer. 2007. Spatial planning system in transitional Indonesia. *International Planning Studies* 12(3):291–303.

Jayawardene, J. 1998. Elephant and Mahaweli: A 15-year study. *Sri Lanka Nature* 2:45–51.

Kumar, P. 2010. *The economics of ecosystems and biodiversity: Ecological and economic foundations.* London and Washington: Earthscan.

Lewis, S. L., and L. White. 2009. Increasing carbon storage in intact African tropical forests. *Nature* 457:1003–1006.

Marengo, J. A., W. R. Soares, C. Saulo, and M. Nicolini. 2004. Climatology of the low-level jet east of the Andes as derived from the NCEP–NCAR reanalyses: Characteristics and temporal variability. *Journal of Climate* 17**:**2261–2280

Matt, F., and R. Gebser (2010), mainly based on Dygico et al. (2006), Tongson and Cola (2007), and others. *Benefit-sharing as key to conserving the Tubbataha Reefs, Philippines.* The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org.

Naik, P. 2008. National Water Award and Bhoomijal Samvardhana Puraskar — 2007, an important step in encouraging rainwater harvesting in rural India. *Current Science* 94(4):431.

Perera, B.M.A.O. (2009) The Human-Elephant Conflict: A review of studies on its current status and mitigation methods. *Gajah, Journal of the Asian Elephant Specialist Group* 30, 41 – 52. http://www.asesg.org/PDFfiles/2009/Gajah%2030/Pages%20from%20Gajah-30-41%20-%2052.pdf.

PPR HOME and PUMA. 2011. PUMA and PPR HOME announce first results of unprecedented environmental profit and loss account. Press release. http://www.ppr.com/sites/default/files/press-release/PRESS_RELEASE_PUMA_PPRHOME_E_PnL_final.pdf.

UN PRI and UNEP FI. 2011. *Universal ownership – why environmental externalities matter to institutional investors*. UN PRI and UNEP FI.

Rafli, T. P., G. Usher, and J. O. Niles. 2007. *Reducing carbon emissions from deforestation in the Ulu Masen ecosystem, Aceh, Indonesia.* The Provincial Government of Nanggroe Aceh Darussalam, Fauna and Flora International, and Carbon Conservation, Aceh, Indonesia.

Sakhuja, N. 2008 Jan. 31. Hiware Bazaar: A village with 54 millionaires. *Down to Earth* 16.

Sangameswaran, P. 2006. Equity in watershed development: A case study in western Maharashtra. *Economic and Political Weekly* 41(21):2157-2165.

Singh, S. 2010. *Hiware Bazaar: A village of millionaires, Maharashtra, India.* The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org.

Sukhdev, P. 2011. *3-D Capitalism.* Web post. http://pavansukhdev.com/2011/04/05/%E2%80%9C3-d-capitalism%E2%80%9D/.

TEEB. 2010. *TEEB Cases*. http://www.teebweb.org/TEEBcases.

——— 2010a. *The economics of ecosystems and biodiversity: Ecological and economic foundations.* Geneva: The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org.

———. 2010b. *The economics of ecosystems and biodiversity: Mainstreaming the economics of nature: A synthesis of the approach, conclusions and recommendations of TEEB.* Geneva: The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org.

———. 2010c. *A quick guide to the economics of ecosystems and biodiversity for local and regional policy makers.* Geneva: The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org .

———. 2009. *The economics of ecosystems and biodiversity: Climate issues update.* Geneva: The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org.

Ten Kate, K., J. Bishop, and R. Bayon. 2010. *The Kennecott Inland Sea Shorebird Reserve.* Geneva: The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org.

Ten Kate, K., J. Bishop, and R. Bayon. 2004. *Biodiversity offsets: Views, experience, and the business case.*

IUCN, Gland, Switzerland, and Cambridge, UK; and Insight Investment, London, UK.

Trumper, K., M. Bertzky, B. Dickson, G. van der Heijden, M. Jenkins, and P. Manning. 2009. *The natural fix? The role of ecosystems in climate mitigation. A UNEP rapid response assessment.* Cambridge, UK: United Nations Environment Programme, UNEP–WCMC.

Wilkinson, C., ed. 2004. *Status of the coral reefs of the world: 2004*, Vol. 1 and 2. Townsville, Australia: Australian Institute for Marine Sciences.

Wittmer, H., and H. Gundimeda. 2010. *A quick guide to TEEB for local and regional policy makers.* The Economics of Ecosystems and Biodiversity (TEEB). http://www.teebweb.org.

World Bank. 2009. Agriculture, value added (% of GDP). http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS.

Wunder, S. 2005. *Payments for environmental services: Some nuts and bolts.* CIFOR Occasional Paper No. 42. Jakarta: Center for International Forestry Research.

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Seminar

4

Policy and Management Tools for Ecosystem Services

Speaker

Pavan Sukhdev

2011 ECOSYSTEM SERVICES SEMINAR SERIES

GORDON AND BETTY MOORE FOUNDATION

Ecosystem Services Seminar 4: Policy and Management Tools for Ecosystem Services

Presentation and Discussion Notes From Speaker: Mr. Pavan Sukhdev

Seminar Series and Seminar 4 Goals:

The goal of the multi-session seminar is to educate the broader conservation community including practitioners and funders on the diverse aspects of ecosystem services – such as how to account for ecosystem services and to effectively measure, manage, and communicate them.

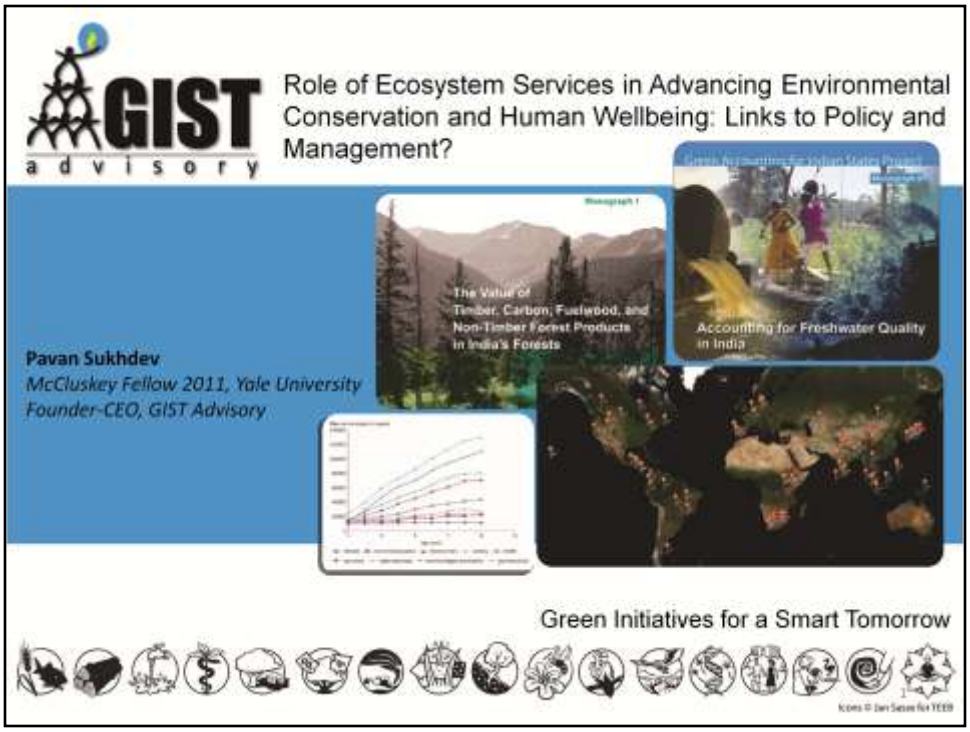
Seminar 4 and associated readings focused on the following goals:

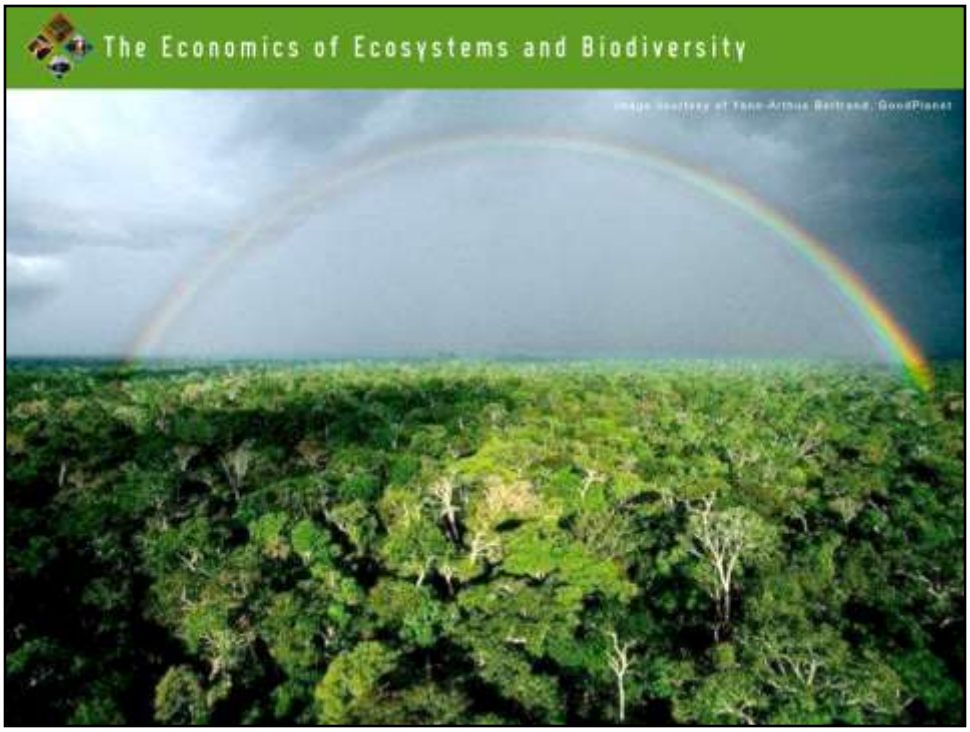
- *Existing tools for implementation*
- *Role and limitations of science in advancing ecosystem services, including data integration and translation to policymakers*
- *Ecosystem services and management planning*
- *Monitoring ecosystem services*
- *Role of collaboration (government, non-profit, and private)*
- *Successes/Failures*

Disclaimer:

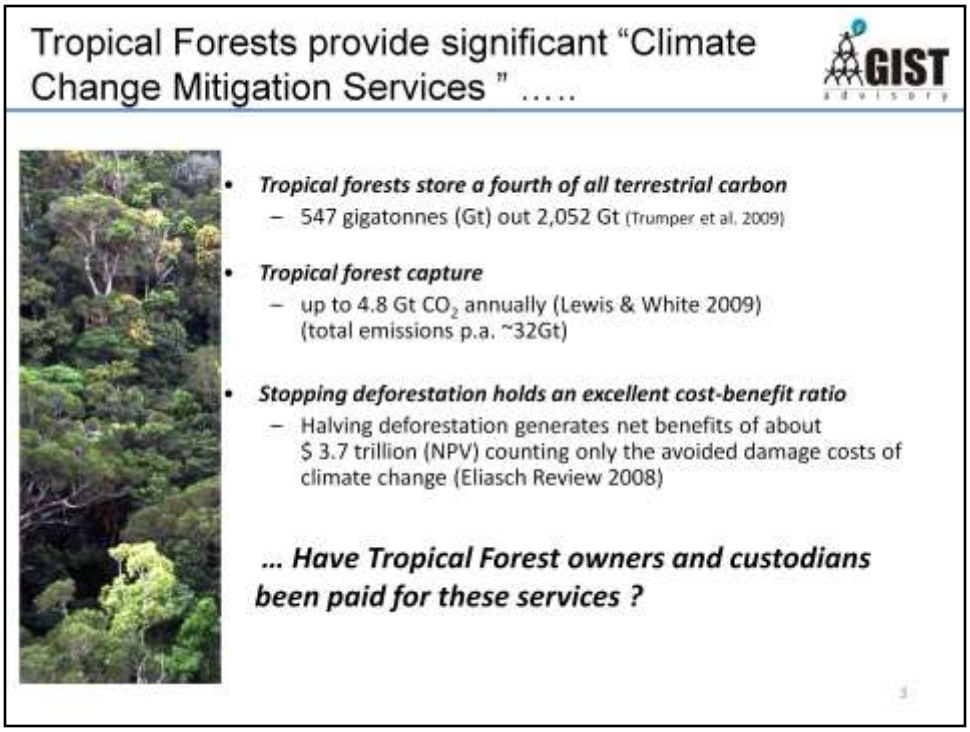
This document is a summary that includes PowerPoint slides from the speaker, Mr. Pavan Sukhdev, and notes of his talking points. In addition, we provide a synthesis of important questions discussed during Seminar 4. Please keep in the mind that the following document is only a recap of Mr. Sukhdev's presentation and Blue Earth Consultants' notetakers have, to the best of their ability, captured the speaker's presentation. We hope that the following presentation and discussion notes will be used as resource to advance further discussions about ecosystem services.

GORDON AND BETTY MOORE FOUNDATION
COASTAL QUEST
BLUE EARTH CONSULTANTS

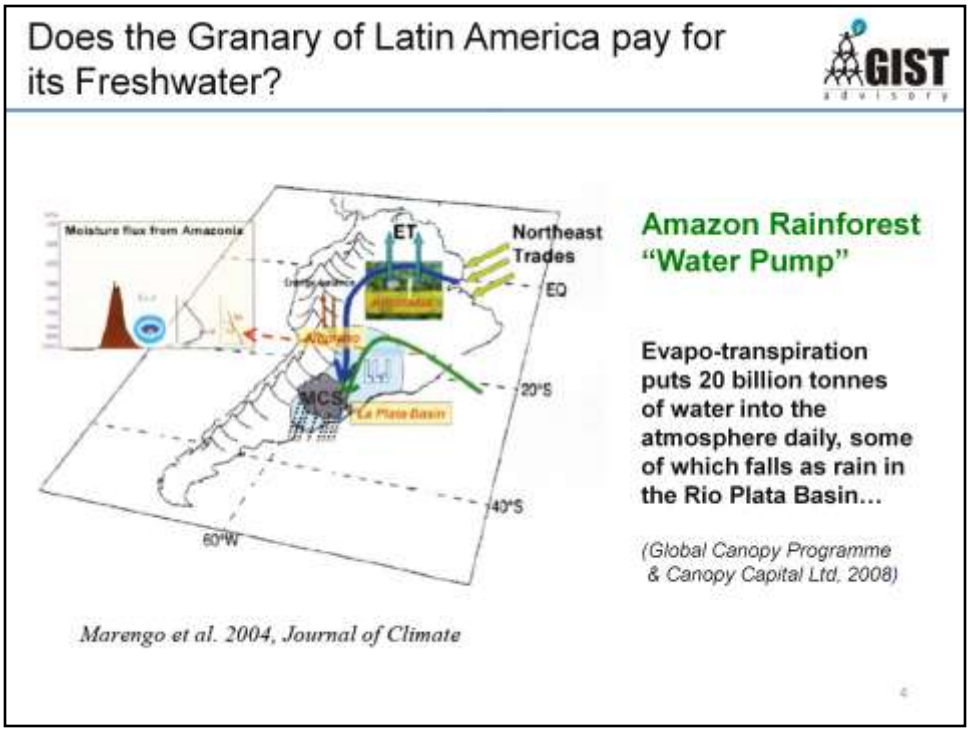

GIST
advisory
Role of Ecosystem Services in Advancing Environmental Conservation and Human Wellbeing: Links to Policy and Management?
The Value of Timber, Carbon, Fuelwood, and Non-Timber Forest Products in India's Forests
Accounting for Freshwater Quality in India
Pavan Sukhdev
McCluskey Fellow 2011, Yale University
Founder-CEO, GIST Advisory
Green Initiatives for a Smart Tomorrow



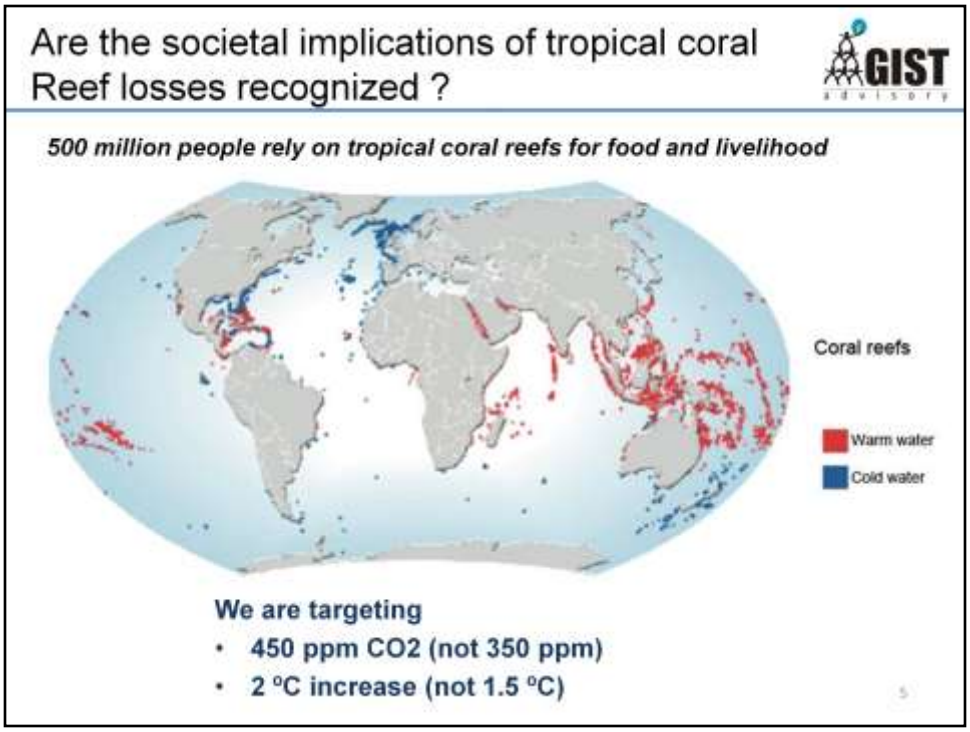
- There is economic invisibility when it comes to nature. We do not recognize nature's value because it is a public good.
- When people think about the Amazon Rainforest, they think about its carbon and biodiversity values. Few think about its ability to supply fresh water (the Amazon is responsible for more than 20% of global river discharge).



- The Amazon contributes to the carbon cycle and captures carbon (the Amazon captures roughly 15% of emissions).
- Numerous studies explain the economic benefits of reducing deforestation of the Amazon, but few account for the water losses associated with deforestation.



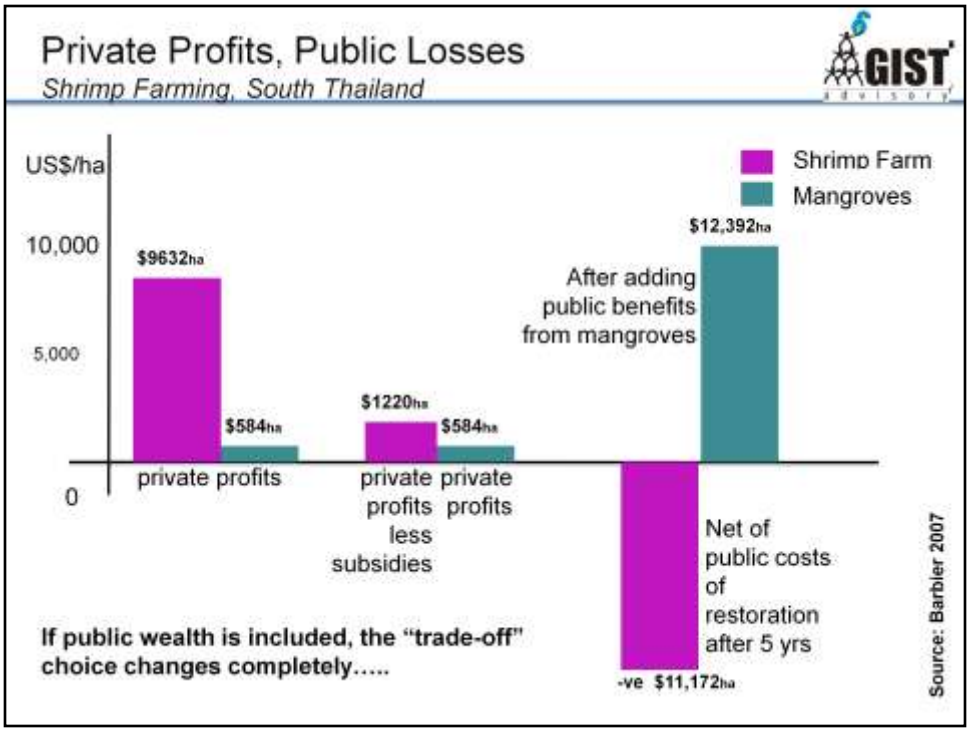
- Even our estimates were not good enough. The image depicts the Amazon Rainforest "water pump," which the Global Canopy Programme and Canopy Capital estimate returns 20 billion tons of water into the atmosphere each day. This picture symbolizes the important message that needs to be conveyed to the public. We all learned about the water cycle in school, but making the connection to geography is also important.
- NASA satellite imagery shows both the freshwater flows and the massive accumulation of water around the Amazon region. This is the science, but I have yet to see it depicted and translated into applicable education formats. It is challenging to build curricula around the nitrogen, carbon, and water cycles.
- The most important resource is water; however, it is another economically invisible part of nature. For example, the Amazonian economy is estimated around $2 trillion for land-based biomass, while few hands exchange money based on water.



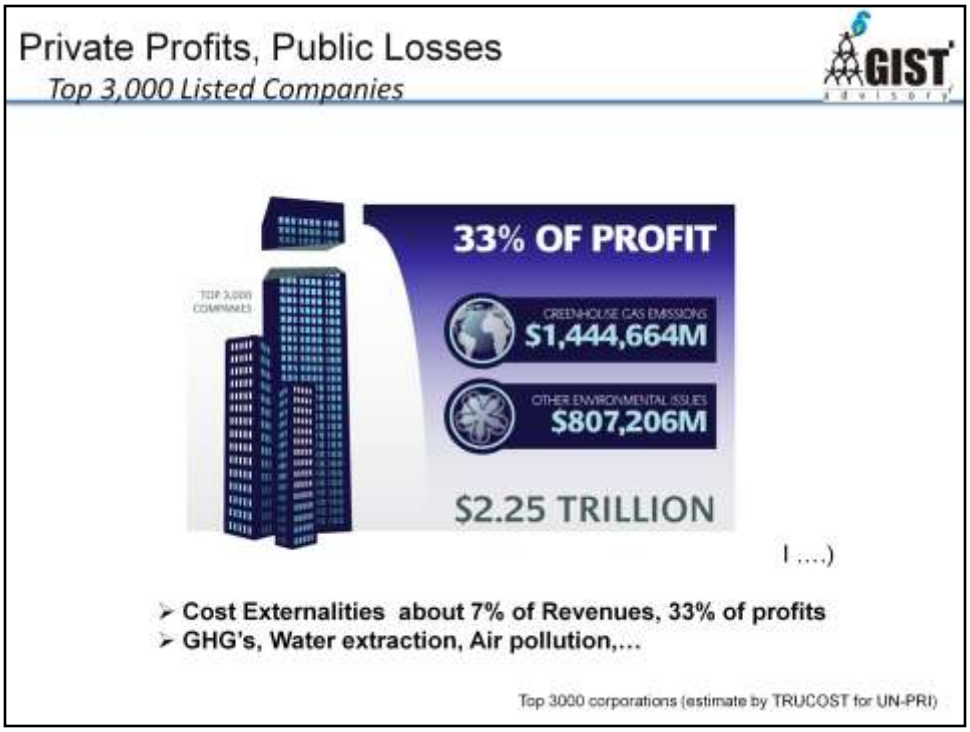
- Another side to economic invisibility has to with the poor and their relationship to nature.
  - ➢How do we manage the risk to the poor associated with loosing nature?
- Coral reefs demonstrate this issue well. We have witnessed huge coral bleaching events and the rate of loss is likely to increase. The health of our coral reefs is a biodiversity issue, but it is also a people issue. These reefs provide employment for many people around the world and provide food for half a billion people or about 8% of the world's population.
  - ➢How do we manage the risk of losing all coral reefs in the world?
  - ➢How do we respond to this loss?
  - ➢How do we help?
- As a society, we seem to have made a choice to kiss coral reefs goodbye, either knowingly or unknowingly.
  - ➢ For reefs to recover, emissions need to fall below 350 ppm, but we have set a target well above that.
- That is the biological story, behind which there is a deeper story.
  - ➢Who is going to deal with the jobs and livelihoods of the people who depend on the coral reefs? Remember, we are talking about 8% of the

world's population.

- The image depicted on the slide shows the distribution of coral reefs around the world. The red dots represent warm corals. You will notice that the locations of warm corals coincide with the global poverty belt. The solution cannot be to move people. The Philippines estimate 25 million people are at risk from declining coral reefs. You cannot recreate jobs in this type of situation; you cannot just move 25 million people inland. They have established lives in these areas and there is nowhere for them to go.
- We need to have a better understanding and appreciation of the natural and human impacts of this loss. We need to understand the poverty dimension. We, in the developed world, will feel the effects to some extent, but not nearly as much as those who live in these places. We will still be able to get fish, maybe not the same kind of fish, but we will get it. For the people who live in these areas, the reef is the lifeblood of the community.



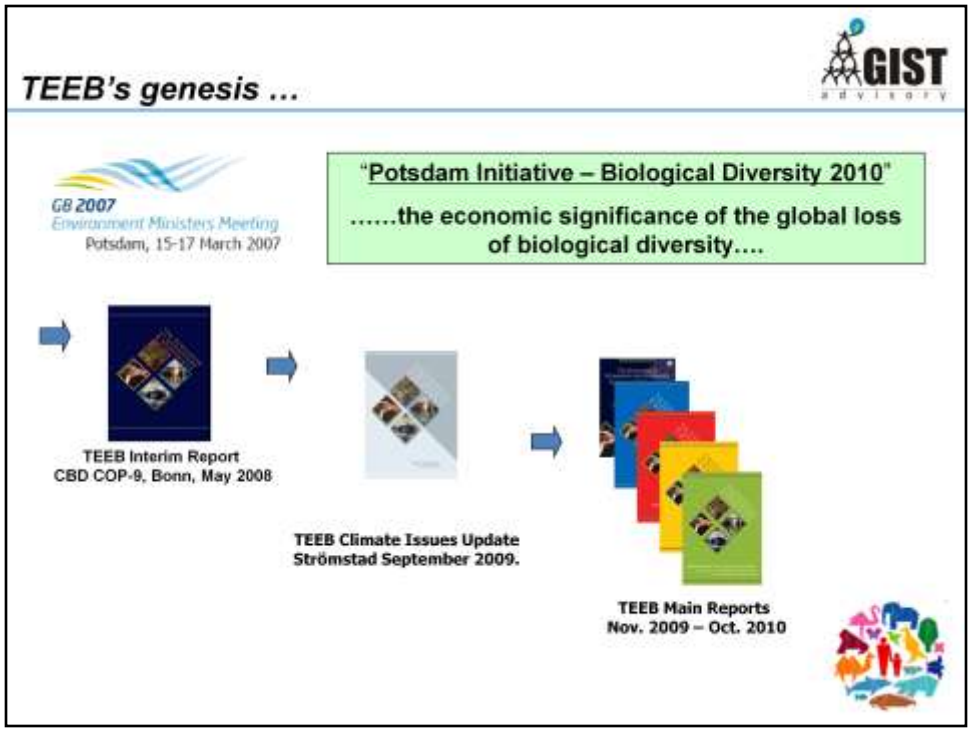
- Again, the economics of this is an untold story.
- A study conducted in Thailand in 2001 and 2007 observed a loss of mangrove forest due to the conversion of mangroves to shrimp aquaculture. This conversion has a huge economic discrepancy. Without subsidies, the conversion of mangroves to shrimp aquaculture is far less attractive; the economic advantage is slight.
- When you start accounting for the ecosystem services (ES) on both sides, the benefits change. During the land conversion, you lose fertility of the land and after a few years, you no longer can have an aquaculture operation. Mangroves also provide additional benefits to local villages such as storm and surge protection and they act as fish nurseries. You wind up with a completely different tradeoff diagram when you include these public wealth factors.
- This represents an important third aspect – private profits direct shrimp farming not public wealth.



•The previous story about shrimp farming in Thailand is not unique. All over the world, private profits win over public profits.

•A True Cost study examined a database of 3,000 companies. The cost of all 3,000 continuing with "business as usual" practices was estimated at $2.2 trillion. The cost of their externalities only represents 33% of their profits. The value they are adding to society may be less than the value of their externalities.

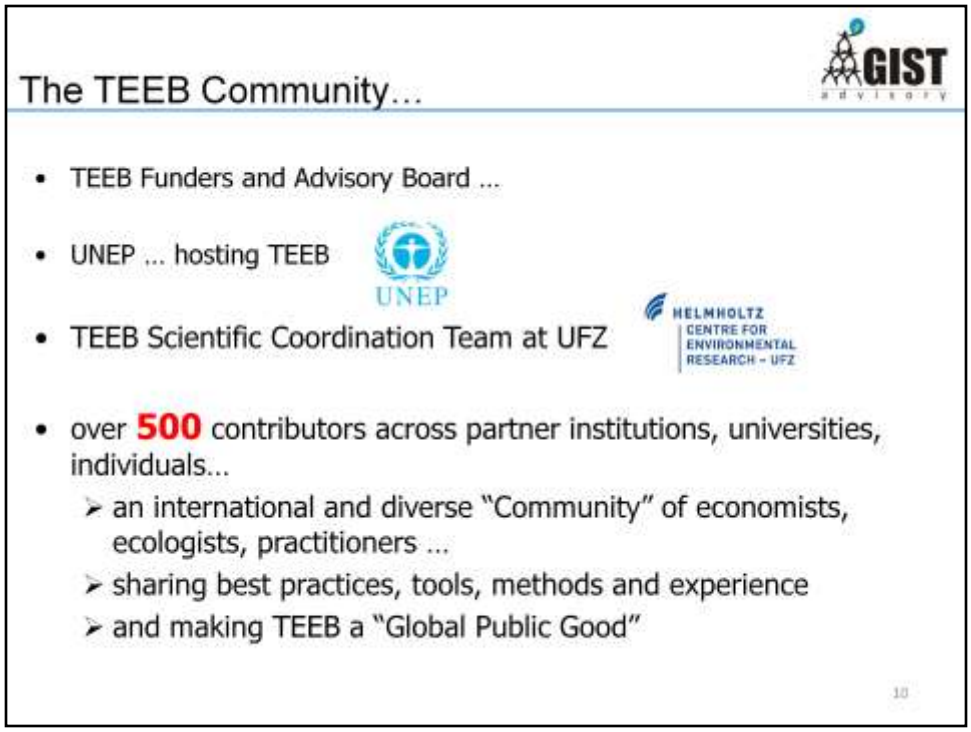
•By the way, none of this is illegal; this is just the way things happen.



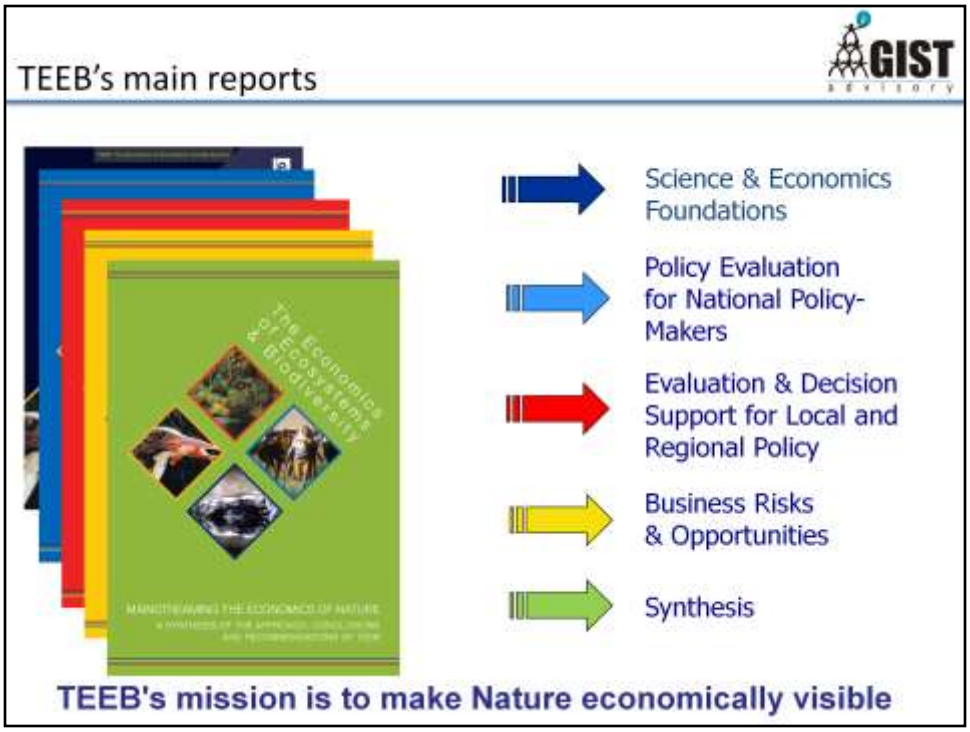
- The True Cost study and the TEEB project set the backdrop for the G8 question, "Can we make an economic argument in favor of biodiversity conservation?"
  - ➢ The answer is that we can, it is just a lot more difficult.
- Biodiversity is complex and changing; it is the living fabric of the planet. We can have a loss at a local scale and yet have a gain at a global scale. There is no such thing as a "percent equivalent." If a species is lost, you cannot just replace with an equivalent, because one does not exist. Everything is location specific.
- As a banker, I received an email asking me to lead the TEEB project. I volunteered carefully. I said I would help with the interim report. I was used to short timeframes; the report took three months to write and everyone appreciated it and liked it.
- Then the real work began. I told them that if they were serious about this project, they would need to write to suggest solutions not to discover the problem. Since solutions vary spatially and are audience-specific, there was no point in writing one massive tome. Writing an over generalized resource would not have been helpful; no one would have read it. In response, I proposed writing multiple audience-specific reports.
- The success of the TEEB reports is directly related to the community who helped create them. There was a collective idea that economic invisibility was a problem and that it needed to be addressed. The TEEB team understood that it needed a community and that no single group had all of the answers. Many people came to

work on TEEB, which was crucial to its success. We estimate that 550 people either wrote or reviewed the reports. In addition, there were thousands of people behind those 550 who contributed. The takeaway is that TEEB was a massive community effort.

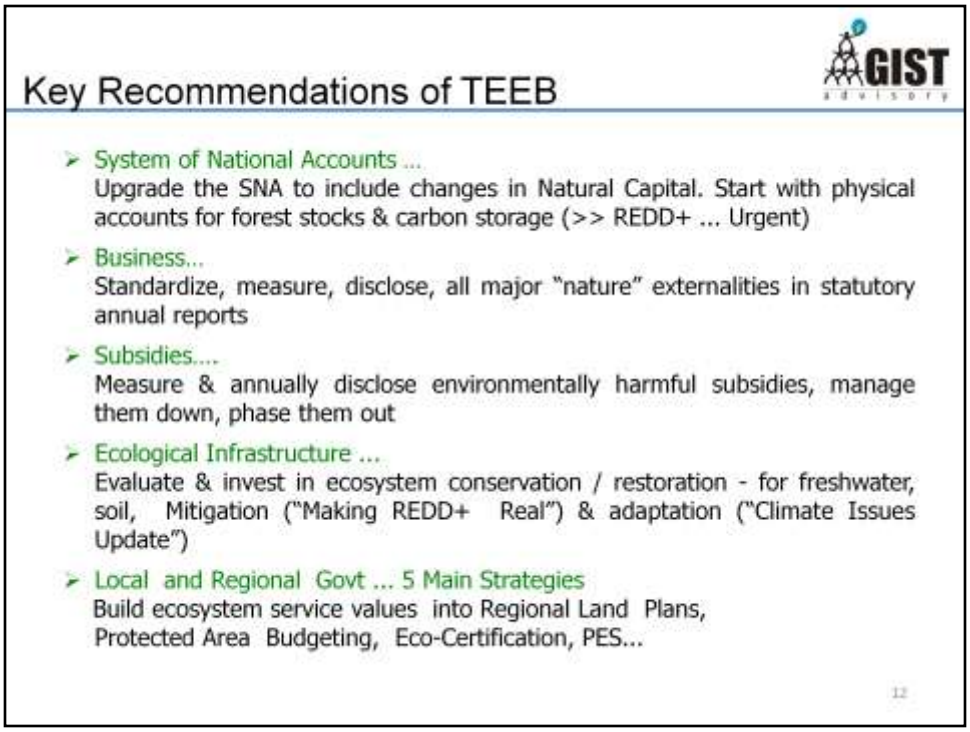
- Frankly, TEEB received $4.5 million funding because it was a wide reaching community effort. In-kind contributions from the community putting in free time likely equal another $3.5 million



- The other key factor in TEEB's success was the high caliber advisory board. We selected representatives who were well known or experts in their respective fields. We chose the heads from groups like UNEP and IUCN. We selected people at the center like David Pierce and Walt Reid. We needed to preserve the connection to the Millennium Ecosystem Assessment (MEA). Despite feeling uncomfortable with the way ES are categorized in the MEA, we wanted to keep that connection.
- Finally, the community had a shared vision, which drove our success. One thing I learned from the entire TEEB process is that a community with a shared vision can accomplish a lot.
- Some of you were at the Consultative Group on Biologic Diversity (CGBD) Montana meeting a few weeks ago, where a great question was posed about what to fund. My response is that funders should look for projects guided by or working with a community united by a shared vision. Those projects will have the most success.



- There are five different reports, the last of which is a synthesis.



- Within the TEEB reports, there are many recommendations. I have listed a few of my favorites on this slide.

National Accounting

- I hope we will touch on this topic in our discussion. It is important because if whatever you are doing does not resonate at the national level, it will fall flat. We need new national accounting system; ES are largely public goods and almost entirely absent from our national accounting schemes.
- Unfortunately for us, natural capital is largely not reflected in national accounts; the losses are huge, but they are not reflected. Private values are captured but public wealth is omitted. GDP does not reflect future incomes, does not reflect ES, and it does not reflect the value of nature. This is a mistake, there is no doubt. Many economists recognize the problem, but no one wants to do anything about it and that has been the problem.
- This challenge will be broken when we work together. The Wealth Accounting and Valuation of Ecosystem Services (WAVES) project is getting up to speed and it is starting to work on this. I hope it succeeds.

Business Side

- The most important need for business is the need to start measuring and disclose externalities in annual reporting. Need a stated method to ensure there is no arbitrage or green washing. As long as companies continue to use and represent

themselves with incomplete balance sheets, they will have no incentives to change their ways.

- Once someone asked me if I knew which palm oil business had a worse impact on Indonesia. I responded saying I had no clue because neither one discloses how much unsustainable palm oil they purchase or where they purchase it from. There is no connection between palm oil and unsustainable deforestation, because the accounting is incomplete. Today we have metrics and accounting is underway.
- We have some information on China's construction, apparel, shoes, and cotton sectors; however, it is still patchy and it needs to happen more often.
- There should be an accounting standard, but the problem is getting the accounting bodies to measure and disclose the externalities. When investors pick up a balance sheet, just as they see disclosure regarding directors' bonuses, the impacts on nature and society, both positive and negative, should be disclosed.

Subsidies

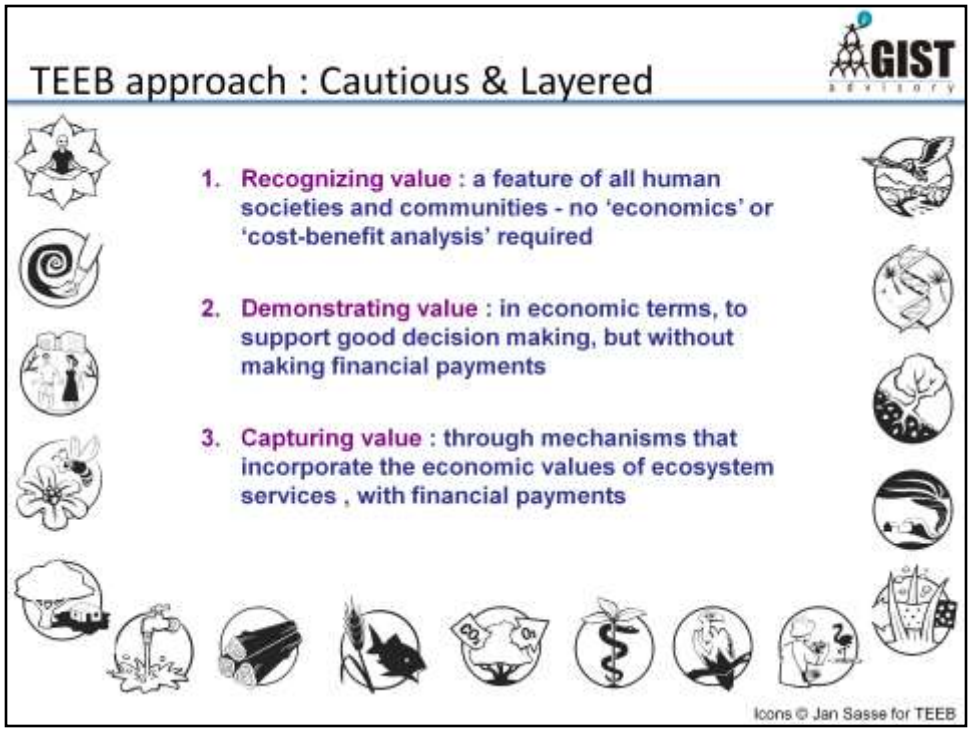
- I am neither the first nor last to say this. We have $650 billion going to oil subsidies and we have $275 billion going to agriculture subsidies. You cannot exclude this; it must be included in the accounting.
- Furthermore, we cannot solve tomorrow's problems with yesterday's solutions. Today, we have enough fossil fuel, we do not need more incentives to go and discover it. I do not have anything against subsidies; they can be good government interventions, but our subsidies today are spending money on yesterday's problems and not those of tomorrow.

Ecological Infrastructure

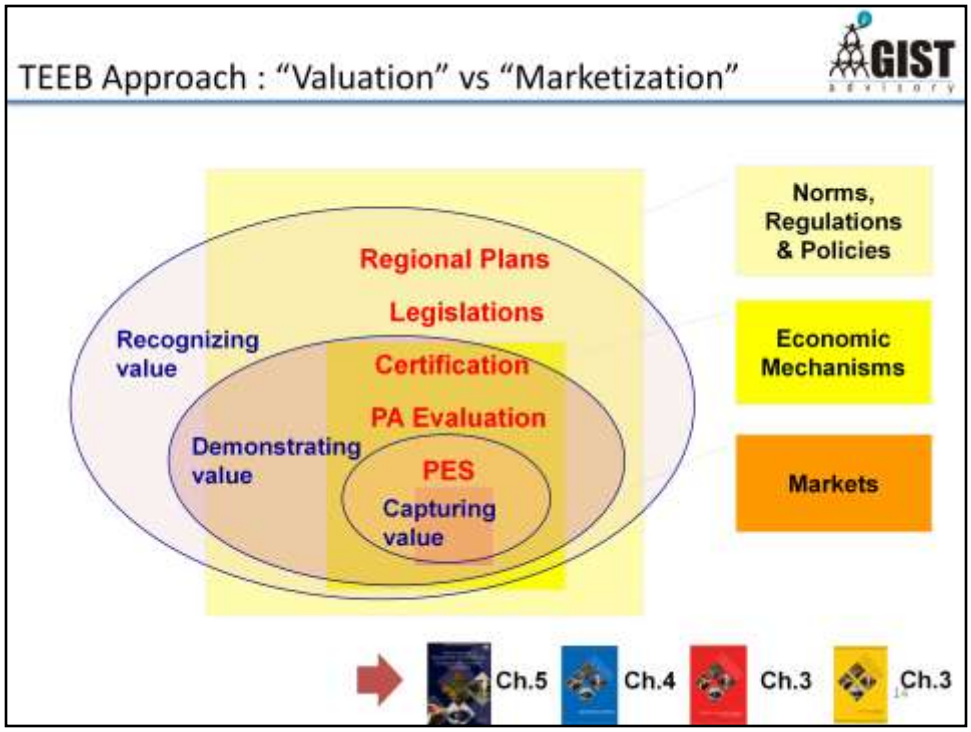
- At the Conference of the Parties (COP) 15 in Copenhagen, we talked a lot about social return on investment. Unfortunately, COP 15 was a wash out; I am hoping the work will continue forward at the Society for Ecological Restoration Conference in Mexico this August. Investment is important.

Local and Regional

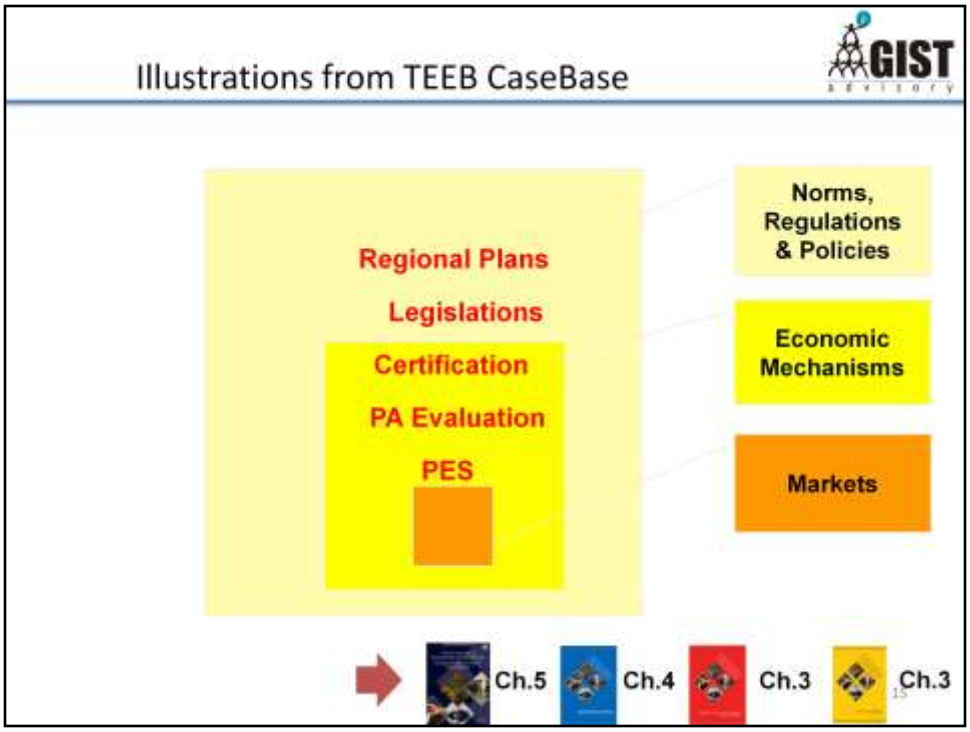
- There is not one best answer; a lot depends on building solutions for the situation at hand. It depends on the context (policy or business) because each demands a different strategy. Through TEEB, we broadly talk about five approaches.



- TEEB did not take a cost-benefit approach. We see valuation as a human institution, as a way for society to give itself feedback. One can give value with no use of economics whatsoever. For example, take a sacred grove. To the local community, that grove has plenty of value and should not be destroyed, yet they communicate the value differently, without the use of economics.
- Communicating or demonstrating values is another challenge for valuation. Look at the images of TEEB. You can guess what ES they represent, some values are easy to express, but others are much more difficult.
- For the values you capture, you can identify a payment for destroying them. For example, you can pay to maintain biodiversity in order to continue harvesting products, i.e. logging, pharmaceuticals, and carbon sequestration. The purpose of ecosystem service payments is to provide compensation.
- Each valuation has its own purpose. Chapter 4 of TEEB was written not by an economist or ecologist, but by a social anthropologist.
- The TEEB view of valuation is cautious and layered through three approaches:
    1) Recognizing Value;
    2) Demonstrating Value; and,
    3) Capturing Value.



- In the diagram, the blue bubbles represent the three TEEB approaches. The words in red are the five types of strategies.
- Regional plans and legislative activities are in the recognizing value stage.
- Certification and Protected Areas (PA) evaluations start to incorporate more values in the demonstrating value stage.
- Payments for Ecosystem Services (PES) are in the capturing value stage because they involve a transaction (someone pays and someone receives payment).



- I find it interesting that not all strategies are what I call market strategies.
- There is a database, which has almost 115 examples of policy changes based on some sort of valuation. About half of them are PES. Twenty-five of them are freshwater PES.
- This gives you an example of where this is working, but they are not all market-based. We should recognize and appreciate this fact.

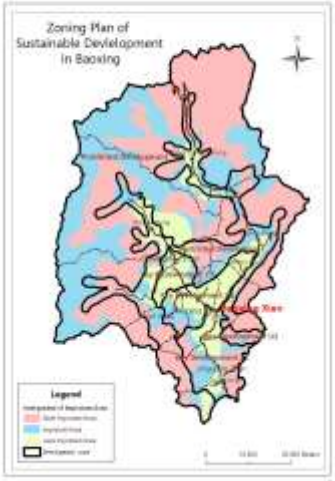
Examples : Integrating ecosystem services into land use plans in Baoxing County, Sichuan, China

GIST advisory

REGIONAL LAND PLANS

An ecosystem service mapping and modeling tool **(InVEST)** used to plan development zones that avoid areas of high ecosystem service provision and conservation importance

Developments were reconsidered by local government officials during the making of the next **Baoxing County Land Use Master Plan 2010** where mapping had highlighted that activities were planned in areas of several critical ecosystem services



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- This is my favorite example of regional and land plans. It involved using InVEST software.
- This is an example where ES was identified and the policy decisions changed based on understanding the ES values.

Examples : Tubbataha Marine Park, Philippines

UNESCO World Heritage site, contains 396 species of corals & has higher species diversity per square metre than the Great Barrier Reef

LEGISLATION

After1998 Bleaching – Stakeholders meeting

"No-take" areas agreed, & later, President passed the Tubbataha Reefs Natural Park Act in 2010 (10 mile buffer zone around the no-take marine reserve) thus increasing Park by 200%

- 10% annual increase in live coral cover.
- fish biomass is four-folds better than the average healthy reef

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- This is another good example from the Philippines. A major coral bleaching event catalyzed this effort.
- After a large bleaching event in 1998, the community collectively decided to create no-take areas. This was based on collective action and it has been very successful. The legislation did not use economic valuation, but it recognized the needs of the community.

Examples : Kampala Wetland

Services provided by the Nakivubo swamp include natural water purification and treatment & supporting small-scale income activities of slum dwellers

P A EVALUATION

Ecosystems services provided by the swamp equal USD 1 million -1.75 million / year

If the swamp is converted then additional investment into a sewage treatment plant would be required with running costs of over USD 2 million / year

(Nakivubo designated a part of the city' s greenbelt zone)

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- The Kampala wetland connects Lake Victoria to Kampala in Uganda. A Study evaluated the cost of converting the swamp to agriculture. The wetland acts as human waste recycler. The value of constructing a new sewage plant was more than the value of keeping the wetland, so they decided to preserve the wetland.

Examples : 'Satoyama' Landscapes'

75 - 100% reduction in pesticides, traditional winter flooding rice farming adopted, & White Stork rice & other certified products sold at a "premium"

Konotori no Mai / Flying Oriental White Stork

PES

2003 - 2007: farmers paid 40,000 JYen per 1,000m^2 of rice paddies .Currently granted 7,000 JYen per 1,000m^2 by Toyo-oka City

CERTIFICATION

Rice sold at 23 % higher rate for reduced pesticide use, and 54 % more for organic farming

- White Stork habitat increased from 0.7 ha in 2003 to 212.3 ha
- Extinct in 1971, now has over 40 breeding pairs
- 1 billion JPY annually in tourism, & municipal income raised by 1.4 %

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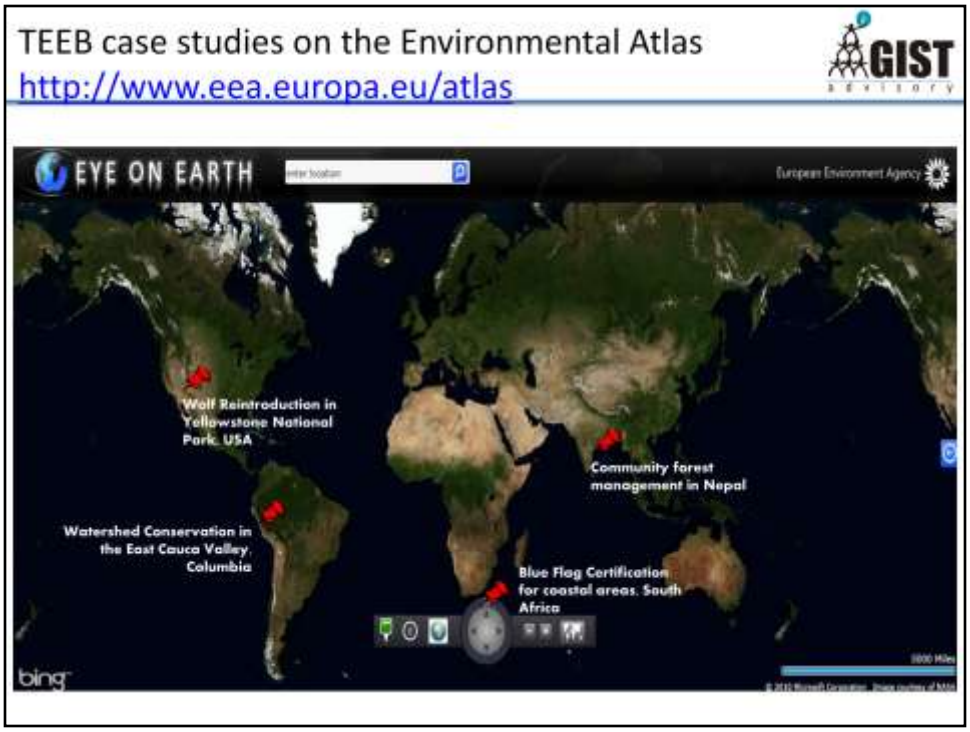
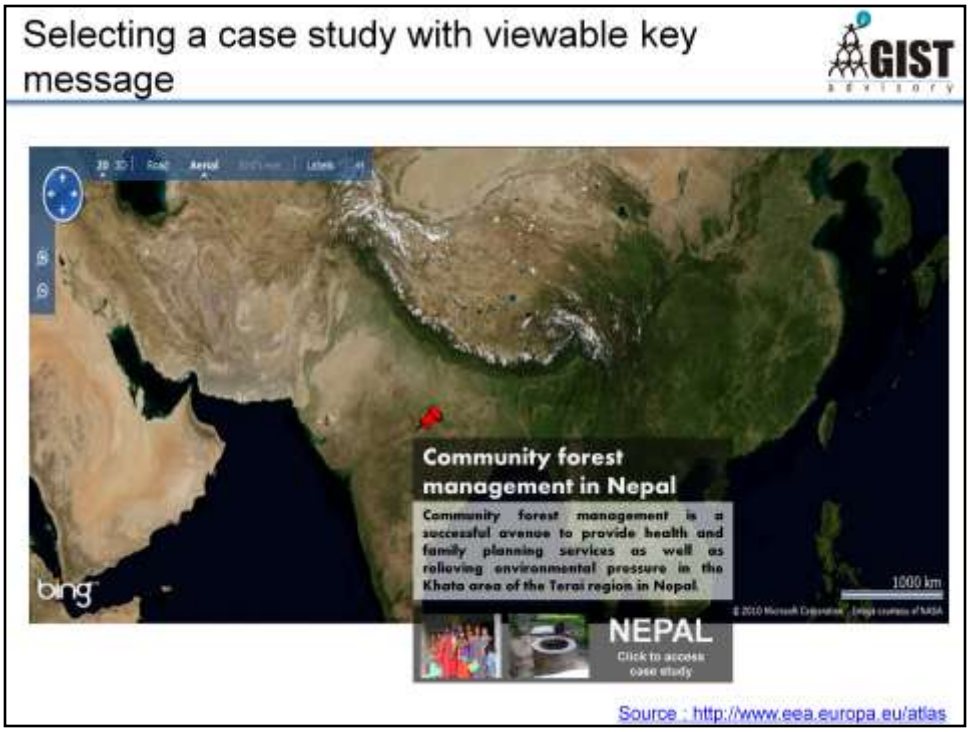
- This is an example of certification and PES from Japan.
- The white stork went extinct in 1971. The city was fond of this bird so they decided to increase the amount of organic agriculture thereby reducing the impacts on a reintroduced breeding pair.
- This was successful because it became a hobby. The farmers were able to sell their rice for a premium as the white stork's habitat increased. Now there is an ecotourism center and the municipality receives increased revenues.
- This is a win-win-win scenario.



- All examples are on the website, http://www.eea.europa.eu/atlas.



- Select an area to get an overview of the project.

- Continue to look at the full write-up, policy solutions, and lessons learned.

REDD in the Ulu Masen Ecosystem, Aceh, Indonesia (collaborative between govt. civil society and pvt sector)

The project uses land use planning and reclassification, increased monitoring and law enforcement, reforestation, restoration, and sustainable community logging on 750,000 ha of forest in the Ulu Masen Ecosystem and peripheral forest blocks located in the Ache Province

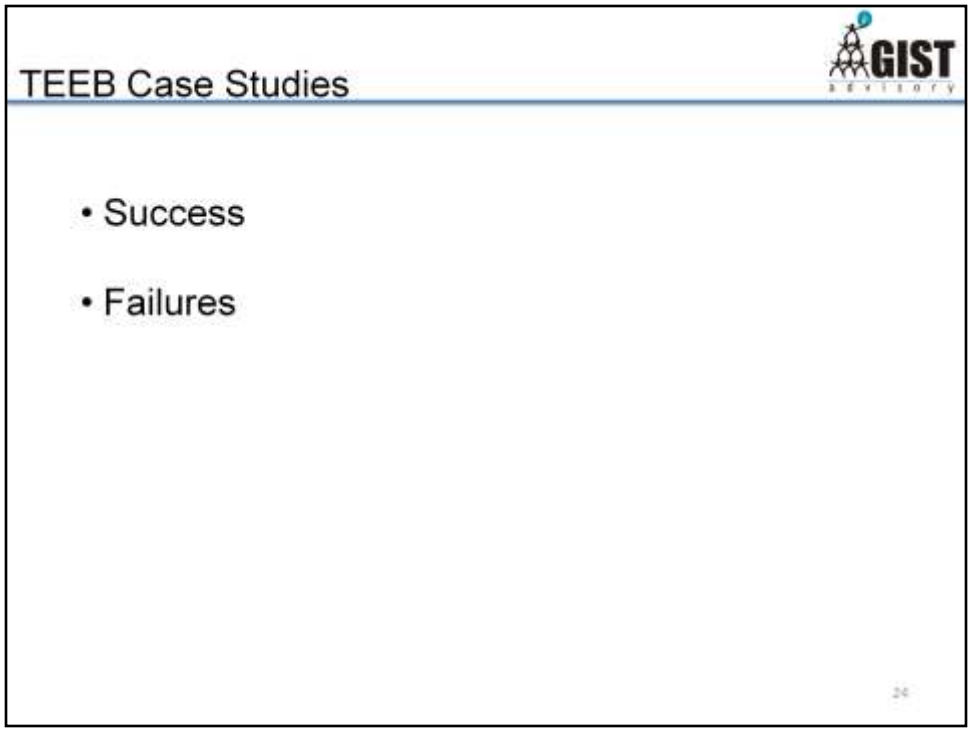
Actors

1. Govt. (Provincial Government)
   - compliance and integration with, governmental and regulatory structures
2. NGO (Flora and Fauna Int.)
   - facilitate participatory processes for community development
   - spatial and land use planning
   - collaborative law enforcement and community based forest management
3. Private (Carbon Conservation Ltd.)
   - project design, development, start-up
   - carbon finance

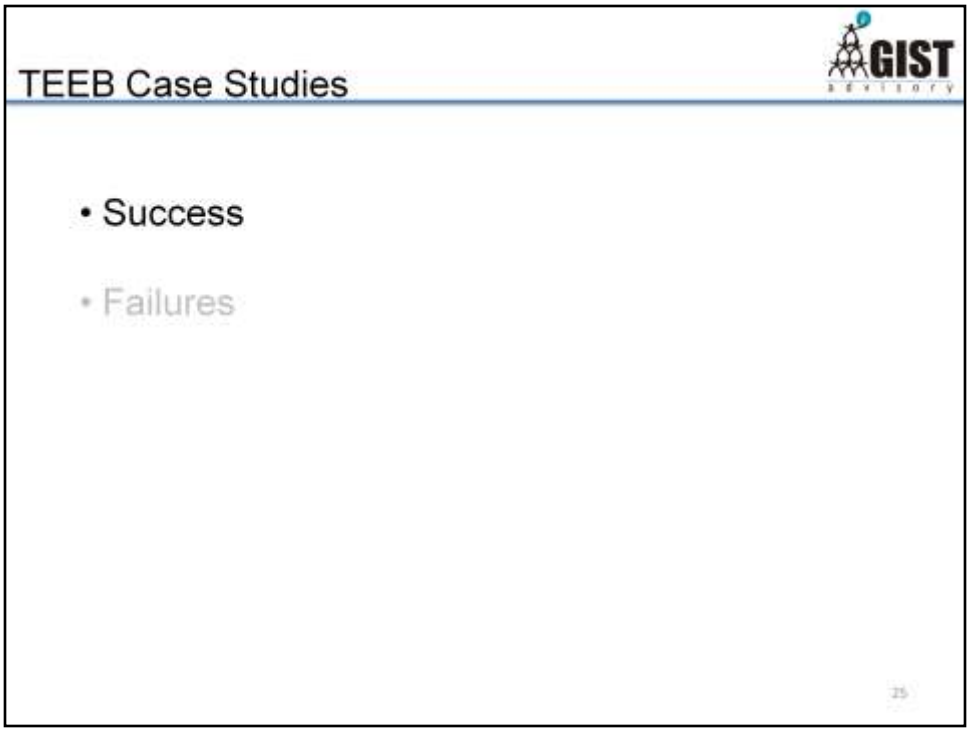
Ulu Masen Ecosystem - Project Area

• estimates proposed activities will reduce deforestation in the area by 85% and 3,369,848 tons of CO2 emissions

- Estimates suggest activity will reduce deforestation and save 3.5 million tons of CO2 emissions.



- Let us talk about some case studies.



- First, we will discuss successes.

Hiware Bazaar- A village of millionaires, Maharashtra, India

The use of an integrated watershed management based development approach have turned a village's misfortune into an ecological and economic success.

- increase the irrigation area from 70 ha (1993) to 260 ha (2006)
- livestock numbers have gone up from 20 in 1998 to 340 in 2003

Hiware Bazaar- before and after

- In Hiware Bazaar, there were stories of farmer suicides because of land degradation and poor water management.
- They worked to capture monsoon rains and develop irrigation. As a result, irrigated area increased and livestock numbers increased.

Hiware Bazaar- A village of millionaires, Maharashtra, India

The use of an integrated watershed management based development approach have turned a village's misfortune into an ecological and economic success.

- one fourth of the village's 216 families are millionaires (in terms of Indian Rupees INR).

Hiware Bazaar- before and after

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- Now it is an icon of ecological development called the "millionaire's village."

Hiware Bazaar- A village of millionaires, Maharashtra, India

watershed development programmes in the country have tried to take a similar approach to regeneration of resources by advocating an integrated, decentralized development model including the NREGA

- the per capita income of the village is twice the average of the top 10 % in rural areas nationwide (Rs. 890 per month = US $ 20 as per 2007 exchange rates).

Hiware Bazaar- before and after

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- The average per capita income has increased and is twice the average of the top 10% of rural village areas.

Ducks Unlimited: Conservation of North American Prairie on Private Lands, North Dakota, USA

Marketing carbon sequestration services of grasslands & helping to fund conservation of highly endangered prairie and wetlands (habitat for hunting waterfowl).

- carbon benefit of preserving and restoring grasslands could be sold in this market and could thereby generate the necessary funds for conservation easements.
- landowners receive compensation that is more competitive to what they could earn from converting grasslands on their property to cropland.
- protection of over 50,000 acres of native grasslands in the Prairie Pothole Region of North Dakota through carbon finance.

Grassland Conversion *Courtesy: Ducks Unlimited*

(Note : From 2002-2007, over 475,000 acres of grassland were converted to cropland in North and South Dakota

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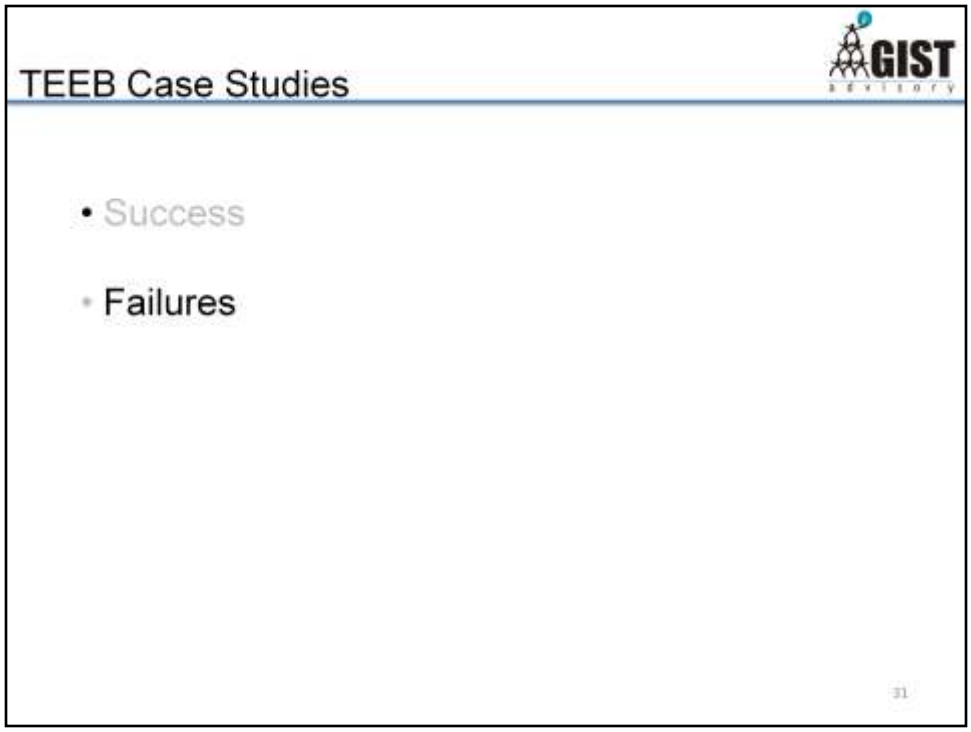
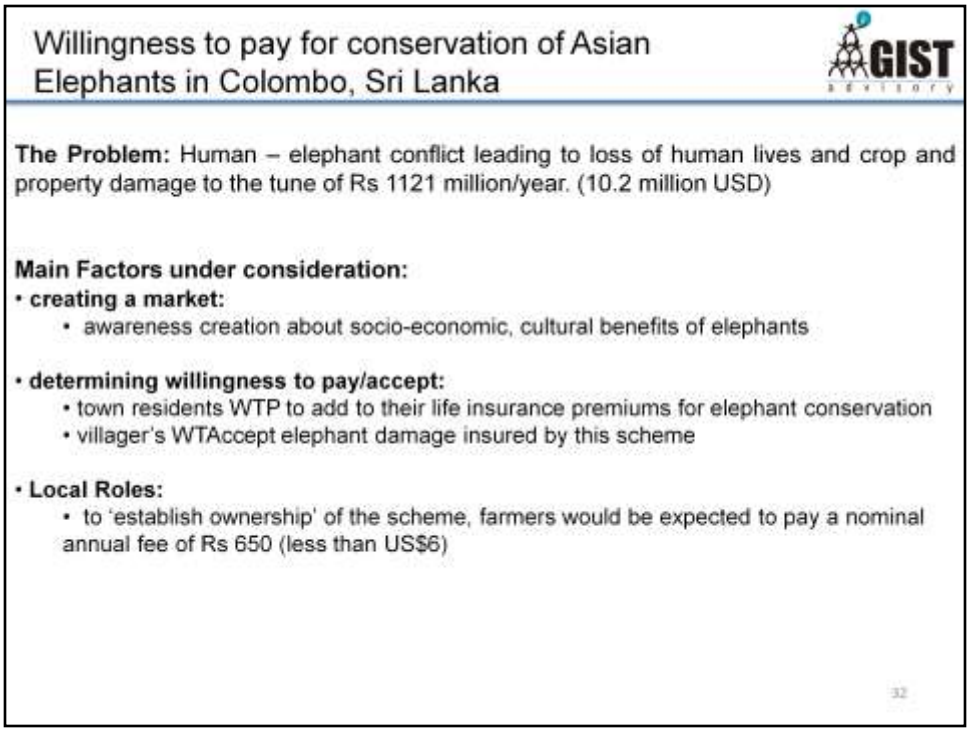
- Grasslands in the United States have a history of being converted to agricultural or grazing lands.
- This example is about measuring carbon sequestration and protecting grasslands through carbon financing.

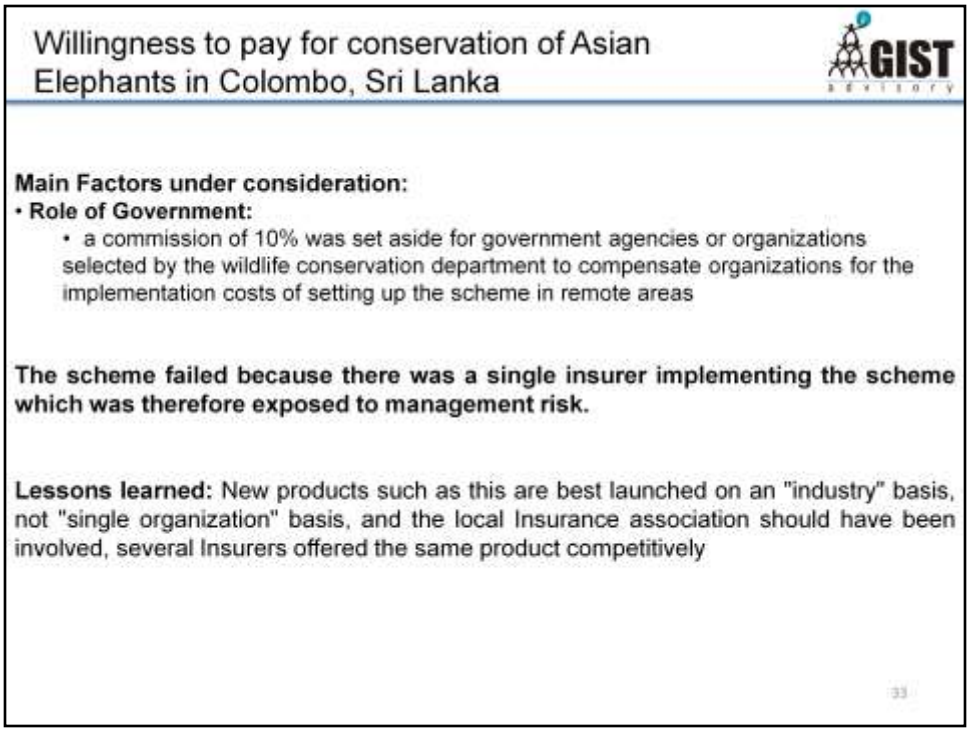
- Utah, USA-Kennecott Inland Sea Shorebird Reserve
- Here again, there is a combination of biodiversity and wetland carbon sequestration interests.



- There are failures too.



- For example in Sri Lanka, where everything seemed fit to succeed, the project did not succeed.
- There was willingness to pay and willingness to accept payment, but it still failed.

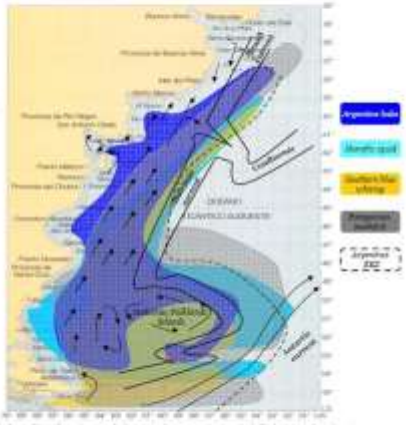


- It seemed to be a strong design because the willingness to pay was greater than the price demanded by those willing to accept. Corruption and scandal hurt the project and it fell flat.
- The lesson is that, if you have an industry role, engage on the industry side. Otherwise, you run the risk of management failure.

Conservation could save commercial fishery in the Patagonian Marine Ecosystem, Argentina

Implementation of conservation strategies is needed to avoid the collapse of commercial fish stocks and the fishing industry.

- due to overfishing, the fish size is decreasing and discards (mainly small juvenile fish) represent between 11% and 24% of total landings between 1990 and 1997
- in economic terms, this represents an annual loss of US$ 11–77 million
- ecological and economic analysis shows that the establishment of conservation zones, the enforcement of fishing quotas and a reduction in fishing efforts, will allow the recovery of fish stock to biologically acceptable levels.



Pattern of the distribution of the main commercial fish stocks in the Patagonian Large Marine Ecosystem. Source: Villasante and Sumaila (2008).

Despite these efforts, quotas still fail to meet the recovery goals because foreign fishing fleets remain unregulated.

- In this marine example, there is a lot of poaching from other nations. Enforcement is weak therefore, quotas fail to meet set goals.
- Although the plan was well designed, the lack of enforcement caused the failure.

Tuul River Watershed Services, Ulaanbaatar, Mongolia

GIST advisory

A Govt. of Mongolia and World Bank initiated study to better understand the ways in which the natural environment contributes to the economy

Findings:

- Upper Tuul watershed generates valuable ecosystem services, which benefit local communities
- conservation and sustainable use scenario is estimated to yield a Present Value, over 25 years, of USD 1.15 billion (Tug 1,370 billion)
- This is appreciably higher than the Present Values generated under BAU at USD 1.09 billion (Tug 1,293 billion)

Recommendations:

- further funding to be put aside for the park management
- there is a potential for payments for ecosystem services, where landowners are paid for the ecosystem services they generate

While there was no policy uptake, the study recognizes that the key challenge is the development of long term incentives for conservation

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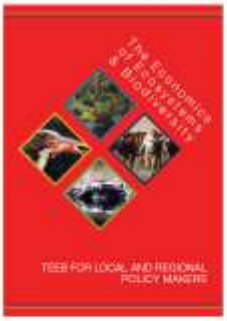
- This example failed due to lack of political support.

Implementing TEEB Approach : Six-Step Assessment

Six steps for effectively appraising ecosystem services

This approach is not a fixed recipe. It is intended to guide policy makers in designing their own processes:



1. Specify and agree policy issues with stakeholders
2. Identify which ecosystem services are most relevant
3. Define the information needs and select appropriate methods
4. Assess ecosystem services
5. Identify and appraise policy options
6. Assess distributional impacts of policy options

- TEEB's six step assessment process.

Applying the approach: Spatial planning in Sumatra

Step 1: Following a new spatial planning law (2007) the Indonesian Government designs spatial plans at district levels. An NGO forum supports Riau districts in preparing spatial plans

Step 2: In Riau, lowland forests are affected by intense logging and forest conversion to plantations, affecting biodiversity, water regulation, and causing erosion

Photo: Ahmad Zamroni/AFP/Getty Images

Step 3: for planning with ecosystem services, their occurrence and their spatial connections need to be known. Assessment with InVEST – a tool for mapping and analysing services.

Source: Natural capital project and TEEB case Integrating Ecosystem Services into Spatial Planning in Sumatra

- This is an illustration of how the TEEB stepwise approach could be integrated with the Natural Capital InVEST Project.
- Sumatra has abundant biodiversity; it is the only place on earth where tigers, elephants, orangutans, and rhinos all reside. Local communities rely on many ES, particularly the provision of a clean, regular water supply for drinking, hydropower, irrigation, protection from floods, droughts, forest fires, landslides, regulation of air pollution, and maintenance of fertile soils for agriculture.

Step 1: Agree on the issue

- In October 2008, the ten provincial governors of Sumatra and four Indonesian government ministers made a historic commitment to protect the remaining forests and critical ecosystems of Sumatra. Local land-use planning is critical for achieving this commitment. Indonesia's national spatial planning process operates on a 5-year cycle. Spatial planning has been undertaken in Indonesia for many years, but has only had a legal basis for measures to enforce compliance since 2007, following the Spatial Planning Law 26/2007 (see Hudalah and Woltjer, 2007).
- In 2010, the Indonesian government is working to design spatial plans at province and district levels. Much decision-making power resides at this local scale because of decentralization. At the national level, renewed spatial planning efforts involve all relevant ministries. At the provincial level, an NGO forum supports planning efforts.

Step 2: identify relevant ES

- Forest conversion, mostly for palm oil, pulp and paper plantations, and illegal logging, are causing losses of biodiversity and degrading many ES. In particular, conversion of lowland deep peat forests – mostly in eastern Sumatra – is a major contributor to global carbon emissions. Existing and prospective forest concessions threaten to have even greater adverse impacts. It is commonly overlooked that forests provide a range of valuable ES, beyond standing timber. The lack of incentives to sustain ES is one of several root causes of these problems.

Step 3: define info needs and choose assessment tool

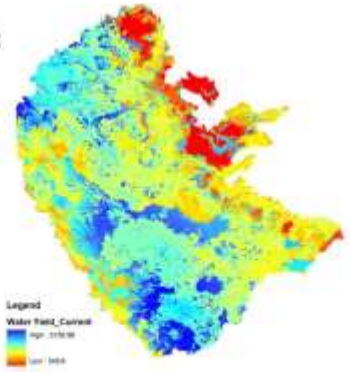
- InVEST provides mapped information on where, and how much, ES are supplied on the landscape, and how these patterns might change under future land use scenarios. It can be overlaid with biodiversity information to see where ecosystem service and conservation priorities overlap. InVEST models are based on production functions that define how an ecosystem's structure and function affect the flows and values of ES. The models account for both service supply (e.g. living habitats as buffers for storm waves) and the location and activities of people who benefit from services (e.g. location of people and infrastructure potentially affected by coastal storms). Since data are often scarce, the first version of InVEST offers relatively simple models with few input requirements. These models are best suited for identifying patterns in the provision and value of ES.

Applying the approach: Spatial planning in Sumatra

Step 4: Based on data from the districts, InVEST modelled services under two scenarios: Sumatra Ecosystem Vision (island wide strategy) and BAU

Step 5: specific recommendation were mad based on the maps: where to restore habitats, where to allocate forest concessions, for which areas to apply for forest carbon PES, ..

Step 6: Focus on global and local ecosystem benefits. Social impact assessment of policy reponses: tbc



Source: Natural capital project and TEEBcase Integrating Ecosystem Services into Spatial Planning in Sumatra

Step 4: Conduct the assessment

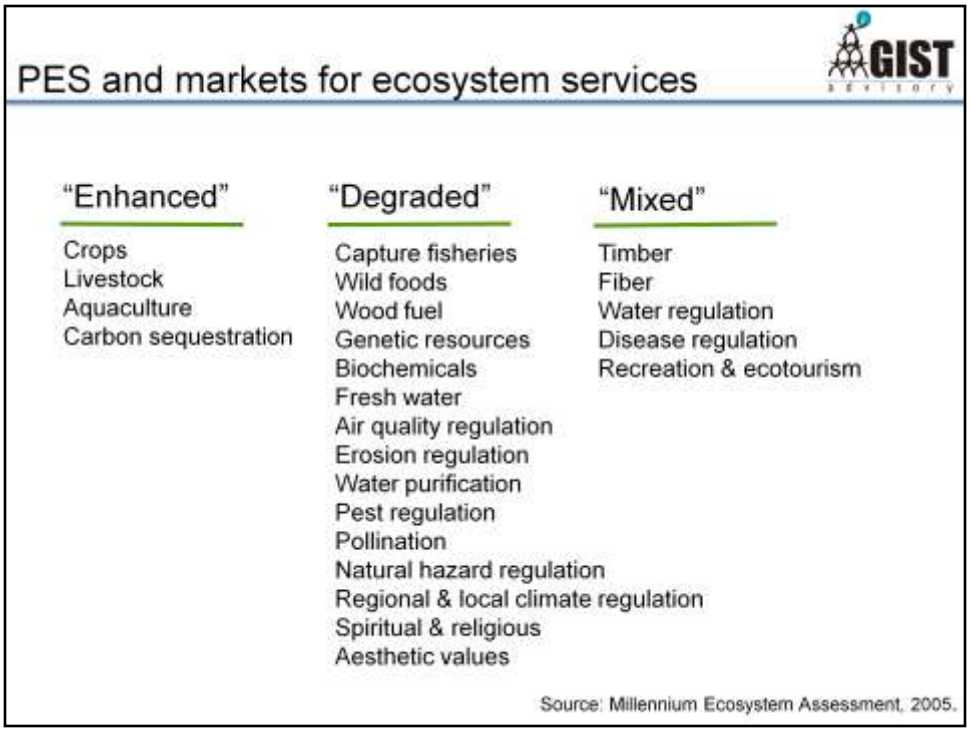
- InVEST was used to model the quantity and location of high quality habitat, carbon storage and sequestration, annual water yield, erosion control, and water purification under two scenarios: (i) the Sumatra ecosystem vision of sustainable land use as proposed in a Roadmap Action Plan, (ii) a business as usual scenario corresponding to the government's current spatial plan

Step 5: Appraise policy options

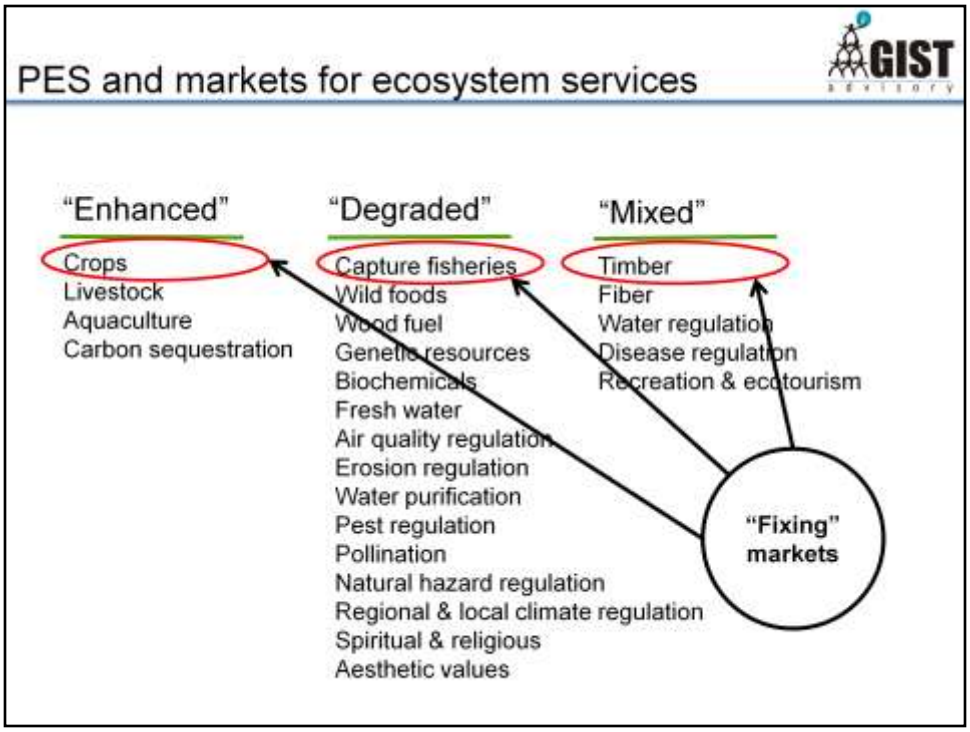
- Results were disseminated to government representatives from nineteen districts. Preliminary recommendations on specific actions were offered, based on the potential gains or losses in ES if the Sumatra Ecosystem Vision (and roadmap) were implemented. For example, based on InVEST results, recommendations were made on how to prioritize areas for forest restoration based on habitat quality and the potential for reducing erosion.
- Information on ES can also be used to advocate for, and help implement incentive mechanisms that reward sustainable land use, such as forest carbon projects, payments for watershed services, certified forestry and agriculture, and ecotourism. InVEST results informed discussions of forest carbon projects by identifying where carbon storage and sequestration potential is high.

Step 6: Assess distributional impact of ES change (due to policy response)

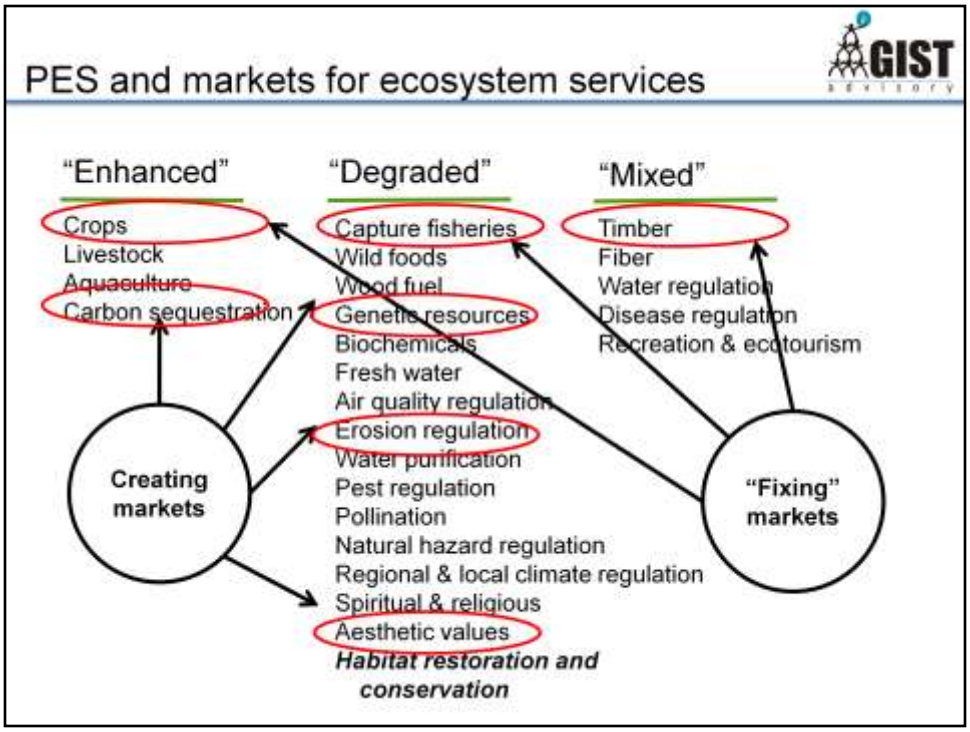
- Focus on global (carbon) and local (water, erosion, etc.) ecosystem benefits.
- Comparison of scenarios showed the social impact due to forest conversion. But social impact assessment of policy reponses is unclear
- The success of InVEST relies of the people who use it.



- The slide lists some of the market-based solutions that exist. I would like to discuss market solutions at the end of the presentation because they do not represent the only solution and it should lead into a nice discussion.
- There are situations where markets are well suited to work but others where they are not. Not everything can be bought and sold on markets, only private claims can be traded in such a way. For instance, markets are not well suited to solve social problems.
- When it comes to public services like carbon, it takes a monumental effort to create one or two success stories.
- Furthermore, when you talk about carbon markets, you are talking about derivatives. That means you are trading the debits and credits of a ledger system. All the problems of derivative markets will affect carbon markets. These compound with the risk of corruption and people stealing.
- This is difficult because you are trying to create rules and develop a synthetic solution to a complex problem so the chances of success are small. We need complex solutions that involve public policy and community cooperation. With that said, there are still opportunities for markets.

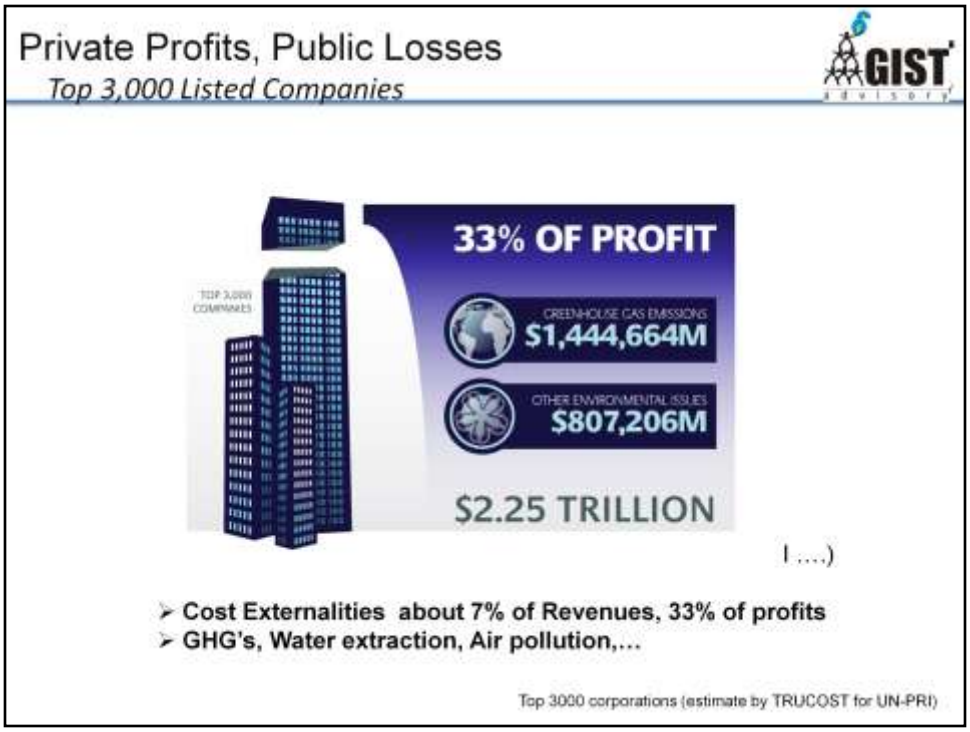


- The circled markets represent those that are "fixing" markets. In "fixing" markets, we can attempt to address externalities through certification. In timber and fisheries markets, we have the Forest Stewardship Council (FSC) certification and the Marine Stewardship Council (MSC) certification respectively.
- Similarly, in the crop markets, you can ensure polluters pay by incorporating a charge for pollution into the value of a good.

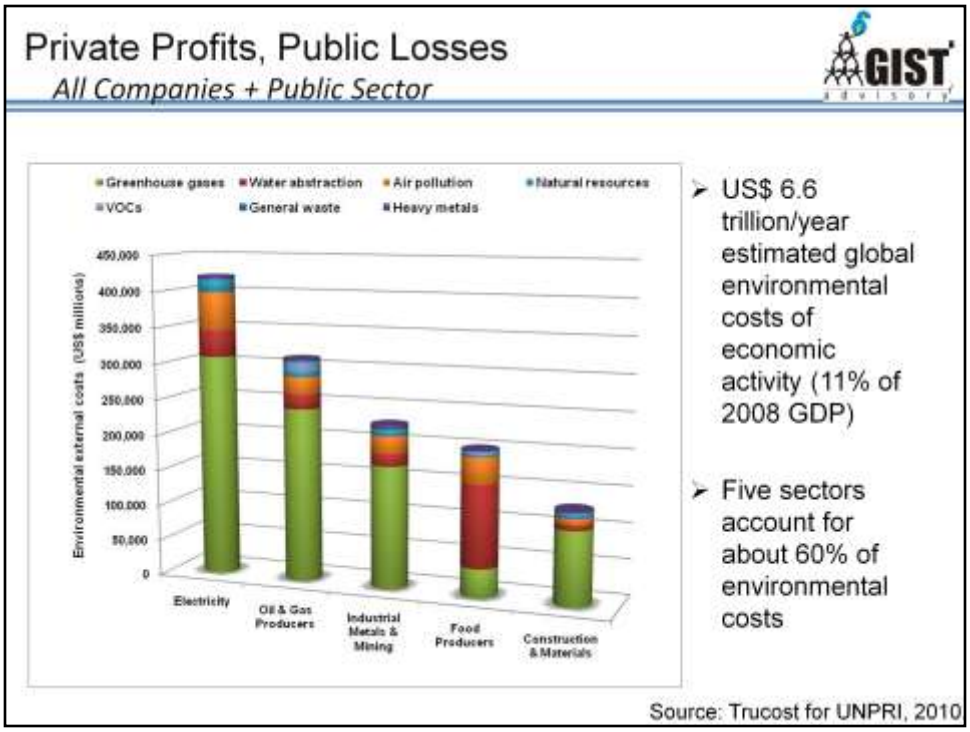


- There are other solutions in "creating" markets.
- This involves creating new markets. For instance, we could create a new market by charging advertising companies each time they borrow an image from nature. Millions of nature images are used each day, but the companies never pay a penny for using nature as inspiration.
- We should not come to the table thinking markets and then wonder why they do not work. Markets are not always the best solution.

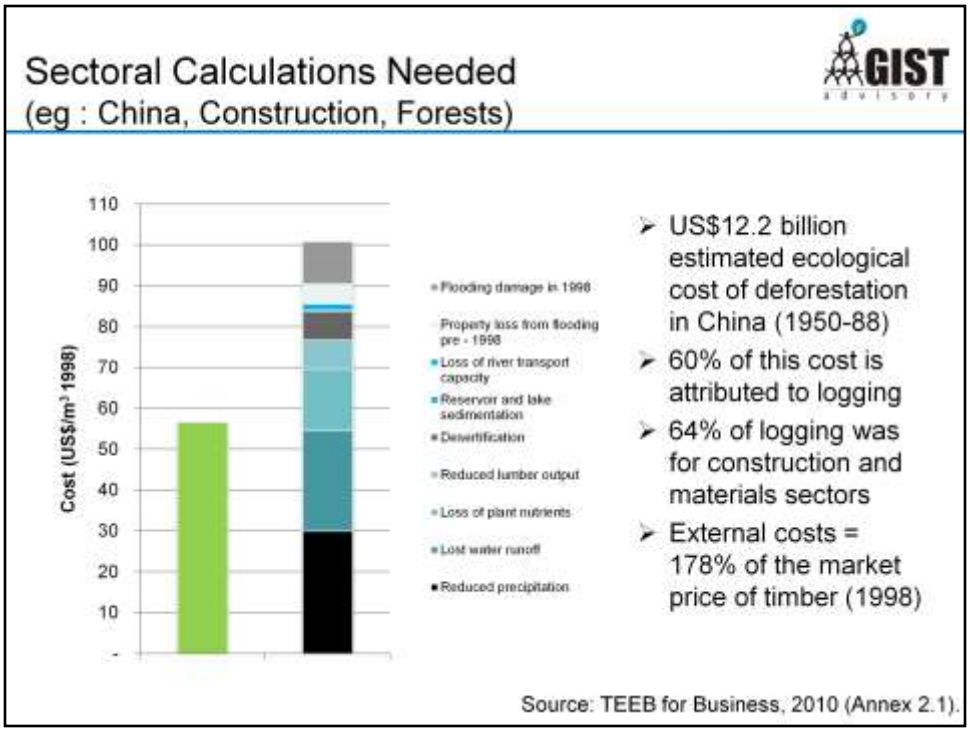
- I am writing another book called *Corporation 2020*.
- I chose to write the book to discuss and show compelling logic for a green economy over a brown economy. We are still not getting the behavior changes that we need because companies seek out resources where good governance is lacking. Today's corporations are hardwired to arbitrage markets.
- I have experience doing this. After success of Mumbai, we needed a regulation-free zone. The Singapore government offered to pay half of our constructions costs so I accepted. This is how corporations think. We have to recognize that these are the things that corporations exploit. They will not look beyond the arbitrage because their main concern is to make profits. The whole point is to maximize profits; corporations are not geared to align goals with society.
- Most importantly, arbitrage tells you to go to market. Global arbitrage is being supported by global markets. It helped buy a whole slew of regulatory changes in international trade. It is wedded to a model that is fundamentally a brown economy. It does not recognize externalities and does not promote a green economy. These are some of the ideas I am trying to address with this book.



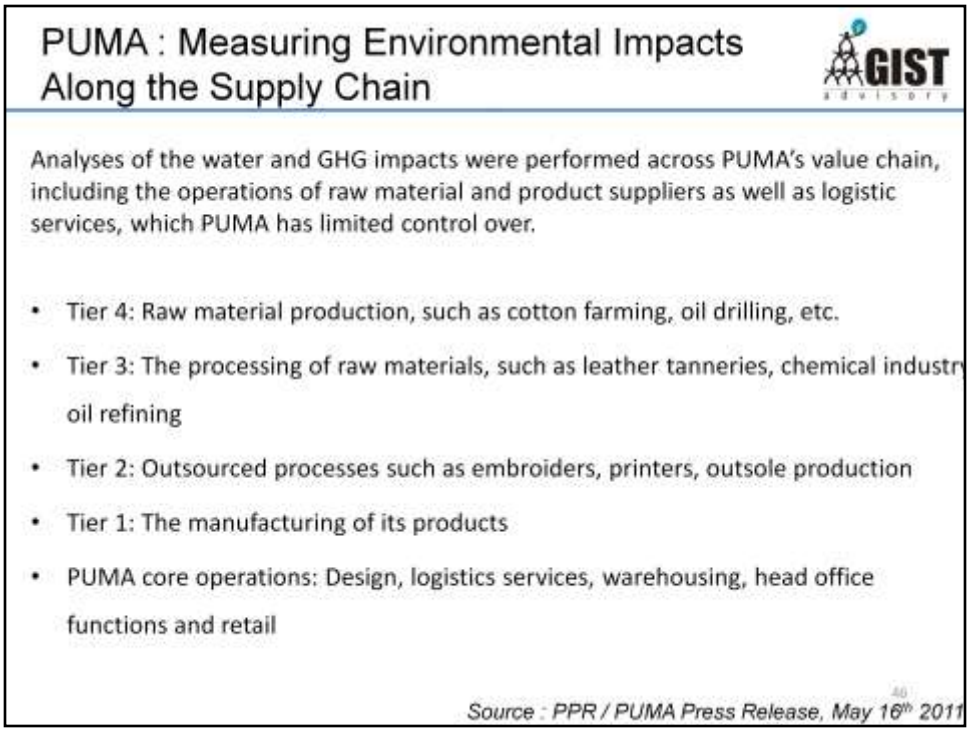
- It is possible to work out the externalities and we need to address them.



- This diagram represents the public loss for private profits by sector.



- This is an example illustrating the real cost of deforestation from timber production in China.
- It shows the local damages: loss of river transportation, decreased water quality, reduction of lumber output. Most lumber was for export. All of these costs are born by China and the profits go elsewhere (to Europe, United States, and other international companies).
- If you add the external costs to the market price, the price of lumber in Beijing should have been 250% of what it was. A construction company should report these externalities, so the costs reflect true costs.



- Reporting will only work if it is on an industry basis. All global construction companies need to get together and agree on a reporting scheme and adhere to it. It cannot just be China doing it while we ignore impacts elsewhere. They cannot shift to importing wood from Indonesia because that just moves the problems somewhere else. It needs to be a united effort.
- We need more visionary companies like PUMA. PUMA examined its entire supply chain based on four tiers.

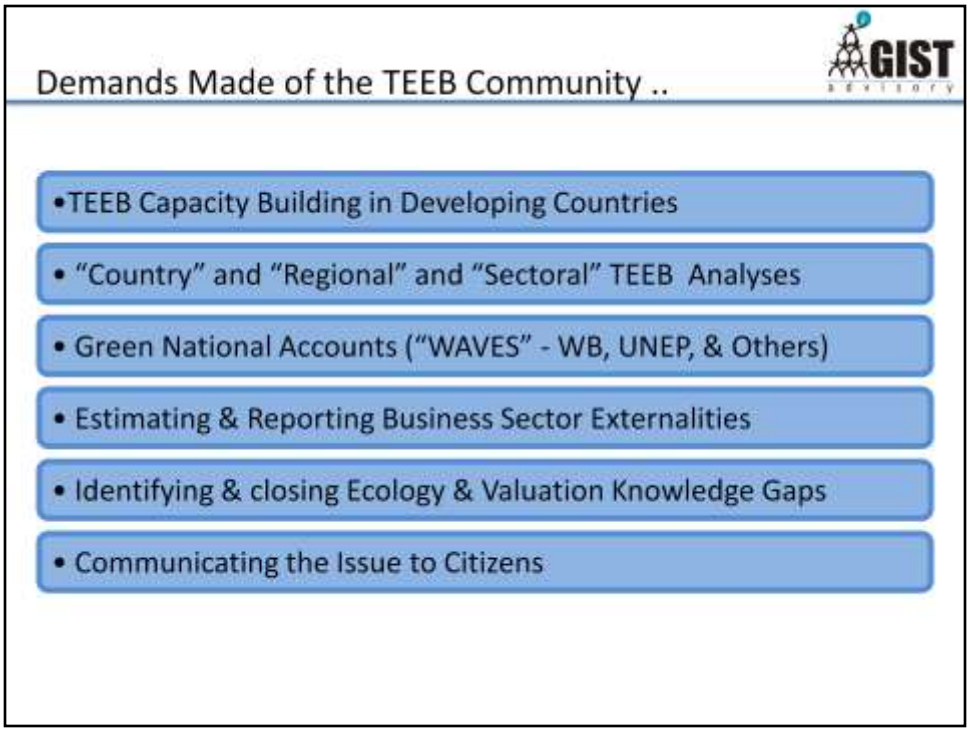
PUMA : Measuring Environmental Impacts Along the Supply Chain

GIST advisory

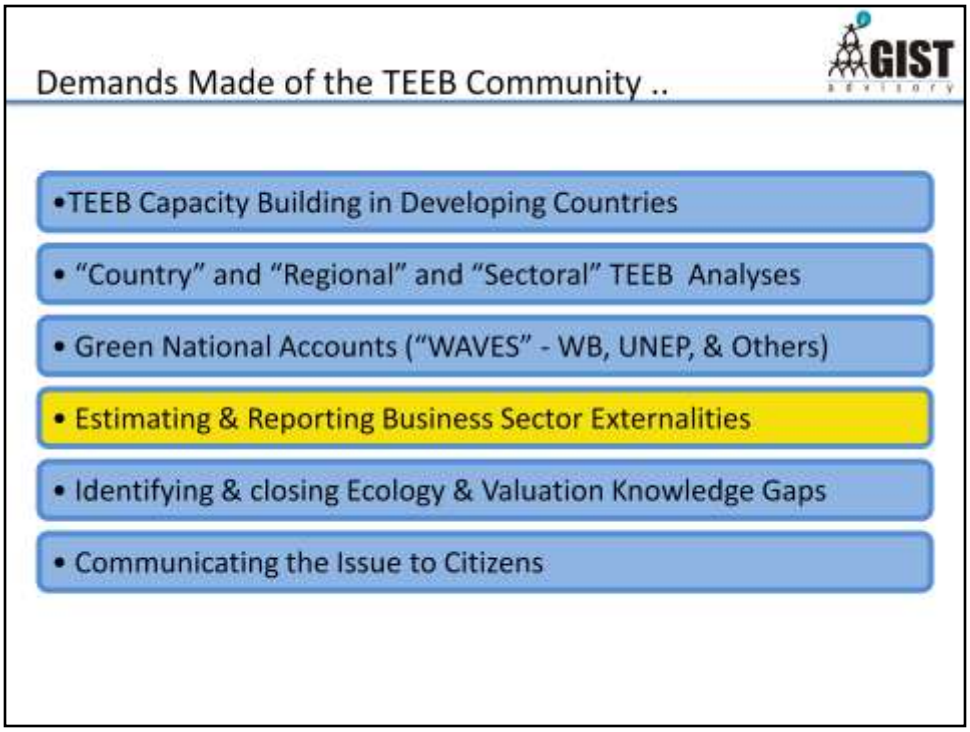
2010	Non-financial performance	Economic value € million	Economic value %
PUMA Operations:			
Greenhouse Gases ($ktCO_2e$)	110.1	7.2	7.6%
Water ('000 m^3)	108.8	0.1	0.1%
Tier 1 suppliers			
Greenhouse Gases ($ktCO_2e$)	131.4	8.6	9.1%
Water ('000 m^3)	5,319.8	0.8	0.8%
Tier 2 - 4 suppliers			
Greenhouse Gases ($ktCO_2e$)	476.0	31.2	33.1%
Water ('000 m^3)	72,064.5	46.5	49.3%
Total:			
Greenhouse Gases ($ktCO_2e$)	**717.5**	**47.0**	**49.8%**
Water ('000 m^3)	**77,493.1**	**47.4**	**50.2%**
Total economic value		**94.4**	**100%**

Source : PPR / PUMA Press Release, May 16th 2011

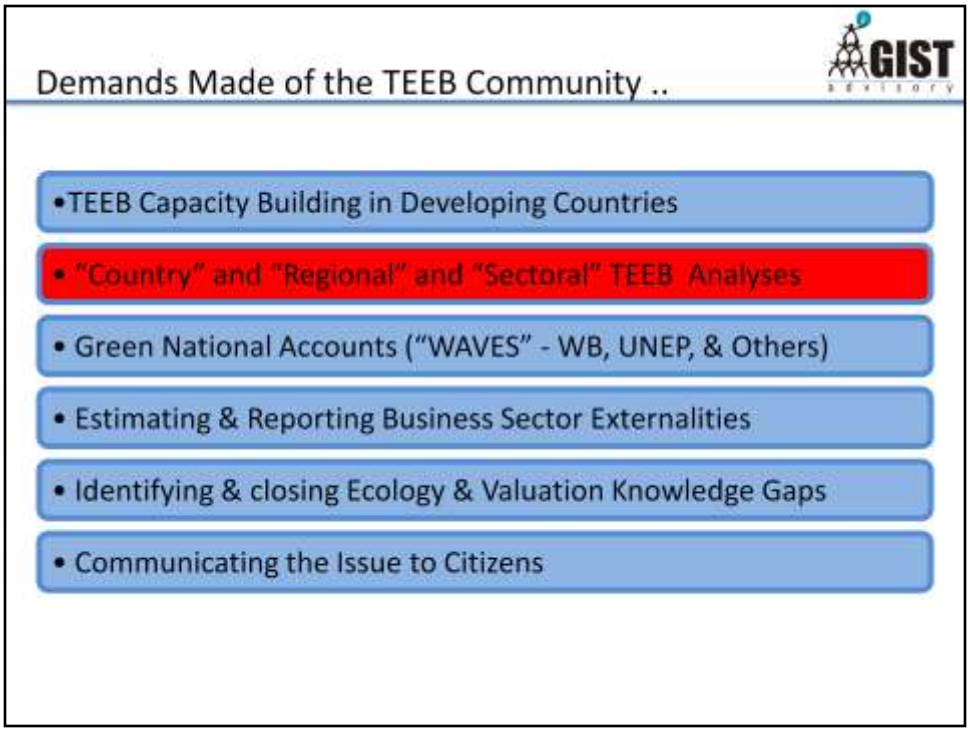
- PUMA looked at its entire supply chain with regard to carbon and fresh water. They discovered that externalities go beyond their direct activities to the activities of their suppliers. Most of the damages to society come from their suppliers' externalities, but PUMA is still accountable because those supplies make up the PUMA products.
- PUMA has a sustainability-conscious executive who recognizes that something needs to be done about the €94 million worth of damages the supply chain causes.
- This is the right way to move forward. When we report externalities, people can have a complete view and understanding of the products. You look at the value chain and then you move forward.



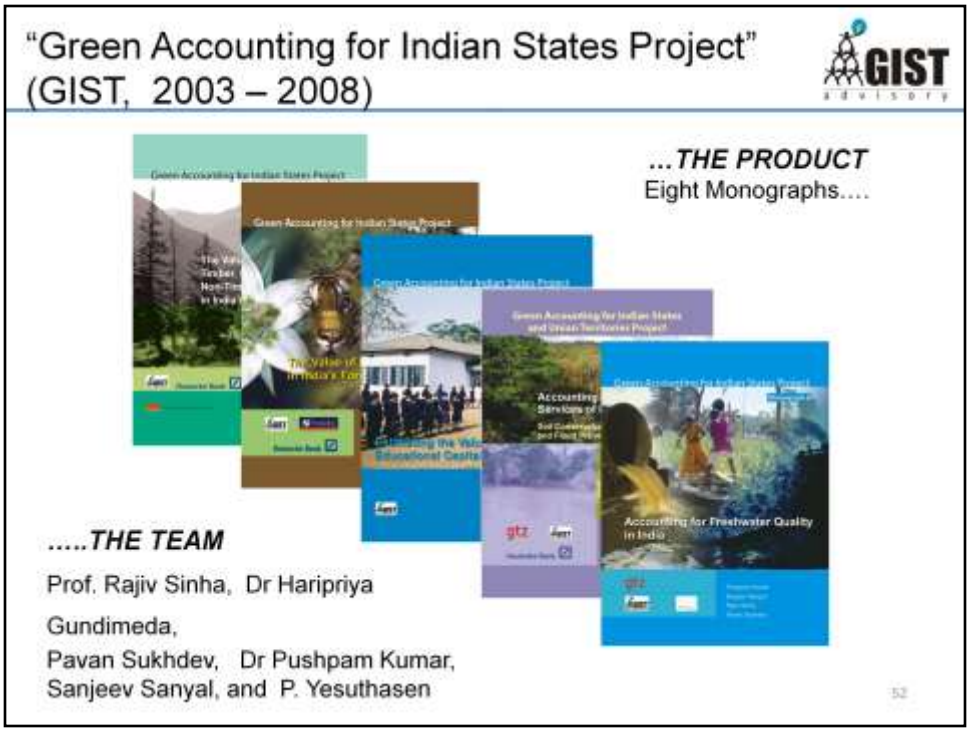
- These are the interests of the TEEB community.


Demands Made of the TEEB Community ..
GIST
•TEEB Capacity Building in Developing Countries
• "Country" and "Regional" and "Sectoral" TEEB Analyses
• Green National Accounts ("WAVES" - WB, UNEP, & Others)
• Estimating & Reporting Business Sector Externalities
• Identifying & closing Ecology & Valuation Knowledge Gaps
• Communicating the Issue to Citizens

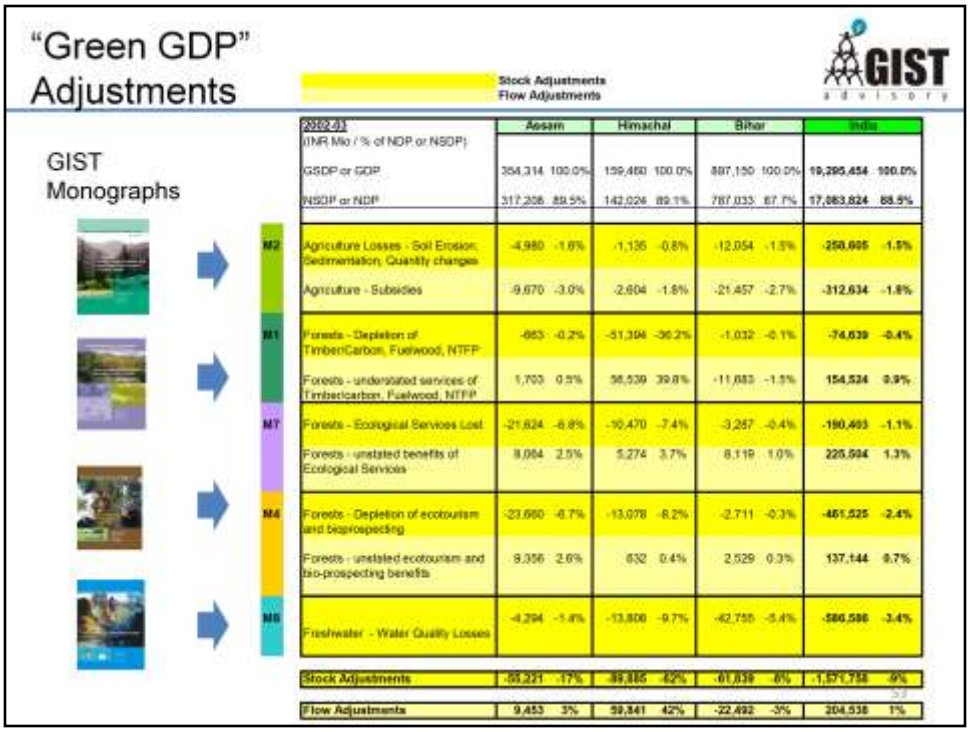
- To address business sector externalities, there is a "TEEB for Business Coalition."
- The group's collaboration is impressive.
- The charge of developing an accounting system for corporate externalities is huge. The good news is that the United Kingdom (UK) has agreed to fund the effort. It will start in the UK and then will move to Brazil and India and so on.
- These are the types of efforts that need funding so that we move together on a united front and avoid developing ten different ways to calculate the same thing. There is a large community working on this and all members share a vision.



- There are opportunities in sectoral and regional accounting areas.



- In full disclosure, I started working with TEEB from my work with green accounting for the Indian States Project. It needs more effort and will have a chance to happen again.



2002-03 (INR Mio / % of NDP or NSDP)	Assam		Himachal		Bihar		India	
GSDP or GDP	354,314	100.0%	159,460	100.0%	887,150	100.0%	19,295,454	100.0%
NSDP or NDP	317,208	89.5%	142,026	89.1%	787,033	87.7%	17,063,824	88.5%
Agriculture Losses - Soil Erosion, Sedimentation, Quantity changes	-4,980	-1.6%	-1,135	-0.8%	-12,054	-1.5%	-250,605	-1.5%
Agriculture - Subsidies	-9,670	-3.0%	-2,604	-1.8%	-21,457	-2.7%	-312,634	-1.8%
Forests - Depletion of Timber/Carbon, Fuelwood, NTFP	-663	-0.2%	-51,394	-36.2%	-1,032	-0.1%	-74,639	-0.4%
Forests - understated services of Timber/carbon, Fuelwood, NTFP	1,703	0.5%	56,539	39.8%	-11,683	-1.5%	154,524	0.9%
Forests - Ecological Services Lost	-21,624	-6.8%	-10,470	-7.4%	-3,267	-0.4%	-190,493	-1.1%
Forests - unstated benefits of Ecological Services	8,084	2.5%	5,274	3.7%	8,119	1.0%	225,594	1.3%
Forests - Depletion of ecotourism and bioprospecting	-23,660	-6.7%	-13,078	-8.2%	-2,711	-0.3%	-461,525	-2.4%
Forests - unstated ecotourism and bio-prospecting benefits	8,356	2.6%	632	0.4%	2,529	0.3%	137,144	0.7%
Freshwater - Water Quality Losses	-4,294	-1.4%	-13,806	-9.7%	-62,755	-8.4%	-586,586	-3.4%
Stock Adjustments	-55,221	-17%	-89,885	-62%	-61,039	-8%	-1,571,758	-9%
Flow Adjustments	9,453	3%	59,841	42%	-22,492	-3%	204,538	1%

- I feel the need for Green GDP in India as the next COP approaches. We have all of the numbers and background, but we need to update it.


Lessons Learnt...
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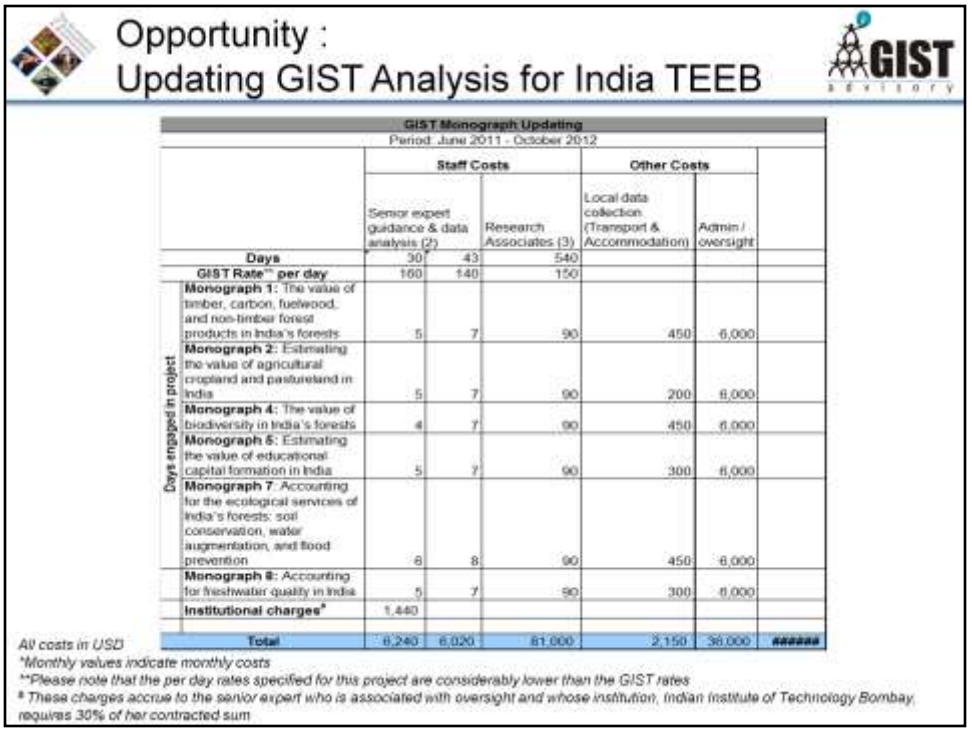
• Work with governments and corporations to discover, evaluate, report, & manage their externalities
• Think big, Start small, Act fast
• A Smart Tomorrow, in which Natural Capital is acknowledged, valued, rewarded & conserved

- The GIST collaborative developed out of these lessons.



Opportunity : Updating GIST Analysis for India TEEB

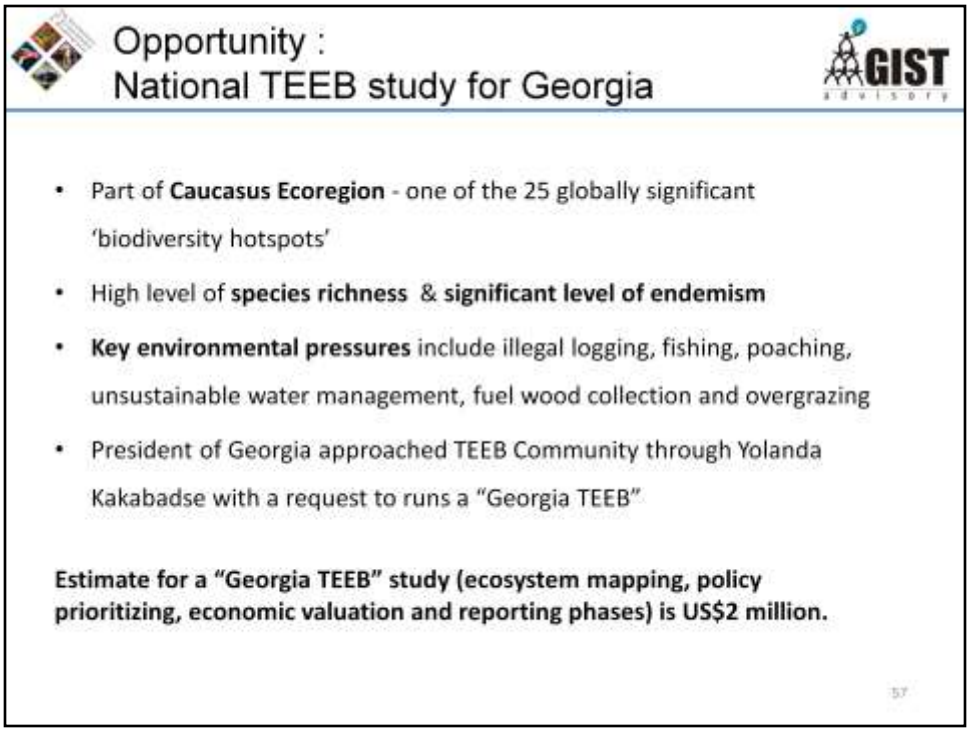
GIST advisory

GIST Monograph Updating
Period: June 2011 - October 2012

		Staff Costs			Other Costs		
		Senior expert guidance & data analysis (2)		Research Associates (3)	Local data collection (Transport & Accommodation)	Admin / oversight	
	Days	30	43	540			
	GIST Rate per day**	160	140	150			
Days engaged in project	**Monograph 1:** The value of timber, carbon, fuelwood, and non-timber forest products in India's forests	5	7	90	450	6,000	
	Monograph 2: Estimating the value of agricultural cropland and pastureland in India	5	7	90	200	6,000	
	Monograph 4: The value of biodiversity in India's forests	4	7	90	450	6,000	
	Monograph 5: Estimating the value of educational capital formation in India	5	7	90	300	6,000	
	Monograph 7: Accounting for the ecological services of India's forests: soil conservation, water augmentation, and flood prevention	8	8	90	450	6,000	
	Monograph 8: Accounting for freshwater quality in India	5	7	90	300	6,000	
	Institutional charges[a]	1,440					
	Total	6,240	6,020	81,000	2,150	36,000	######

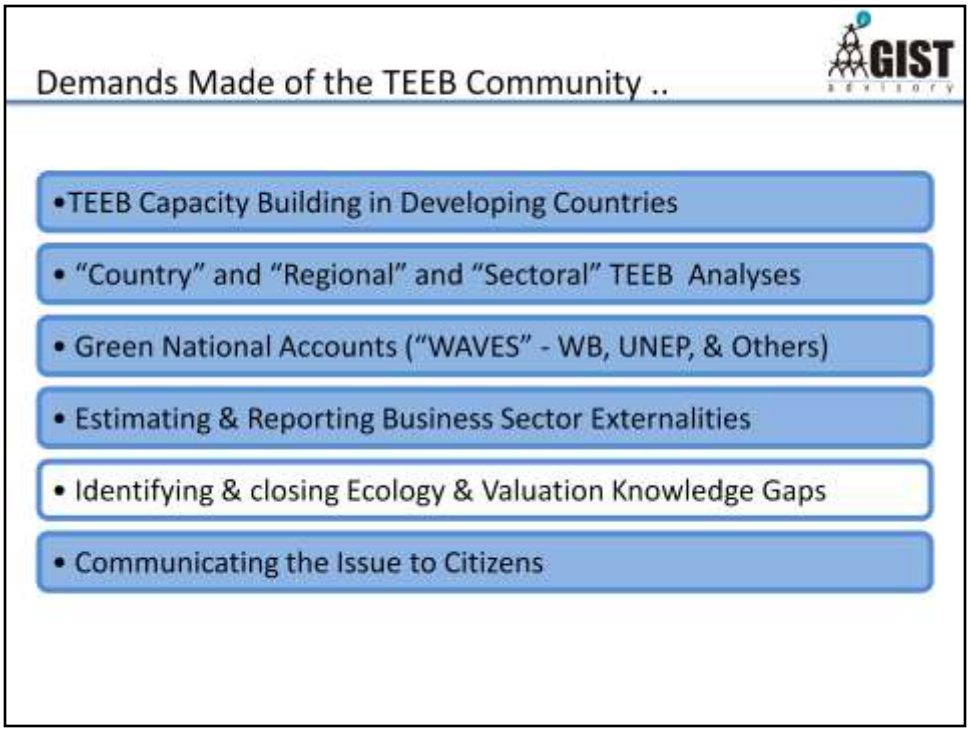
All costs in USD
**Monthly values indicate monthly costs*
***Please note that the per day rates specified for this project are considerably lower than the GIST rates*
[a] These charges accrue to the senior expert who is associated with oversight and whose institution, Indian Institute of Technology Bombay, requires 30% of her contracted sum

- Here is an example of a proposal. It may not be big, only $125K, but think of the impacts and what it could do for the country in terms of global and national policy.



- The President of Georgia wants a full-scale TEEB.
- Georgia is an interesting scenario. It is a small country with incredibly high species richness combined with high logging pressure and fish poaching.

- There is good progress putting together a proposal for a TEEB for agriculture. It will measure the impacts of subsidies on agriculture, the economics of agricultural waste, etc.
- People keep forgetting that if you export food grains, you are importing water shortage. The more numbers we have will only help us develop a better picture to communicate this issue to the public. It is a biodiversity issue because where you export to where you import makes a difference.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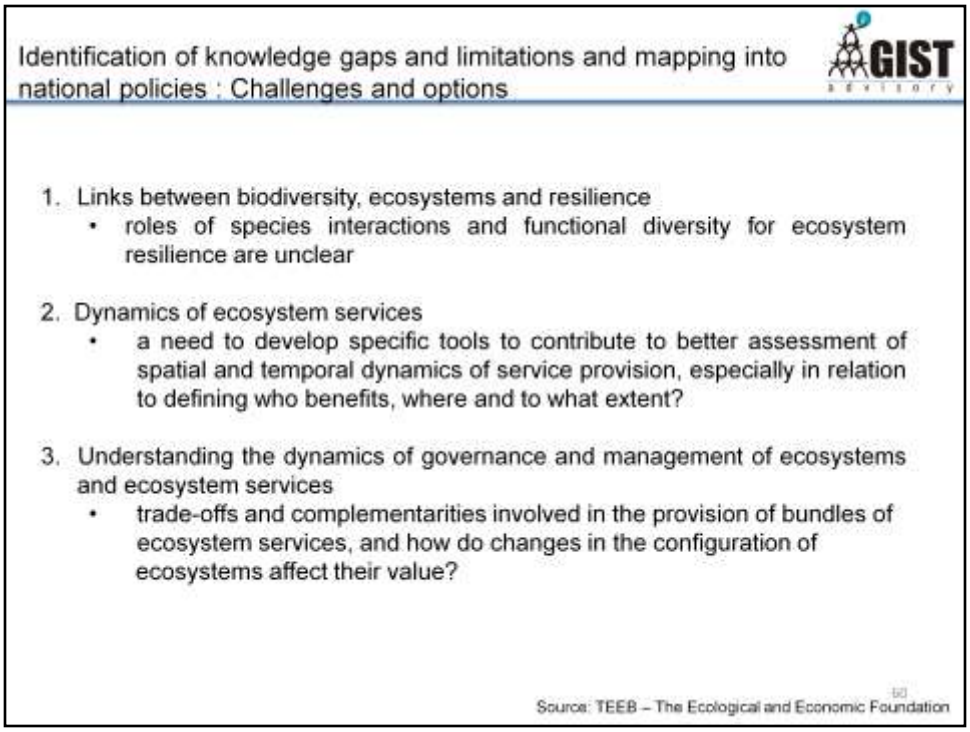
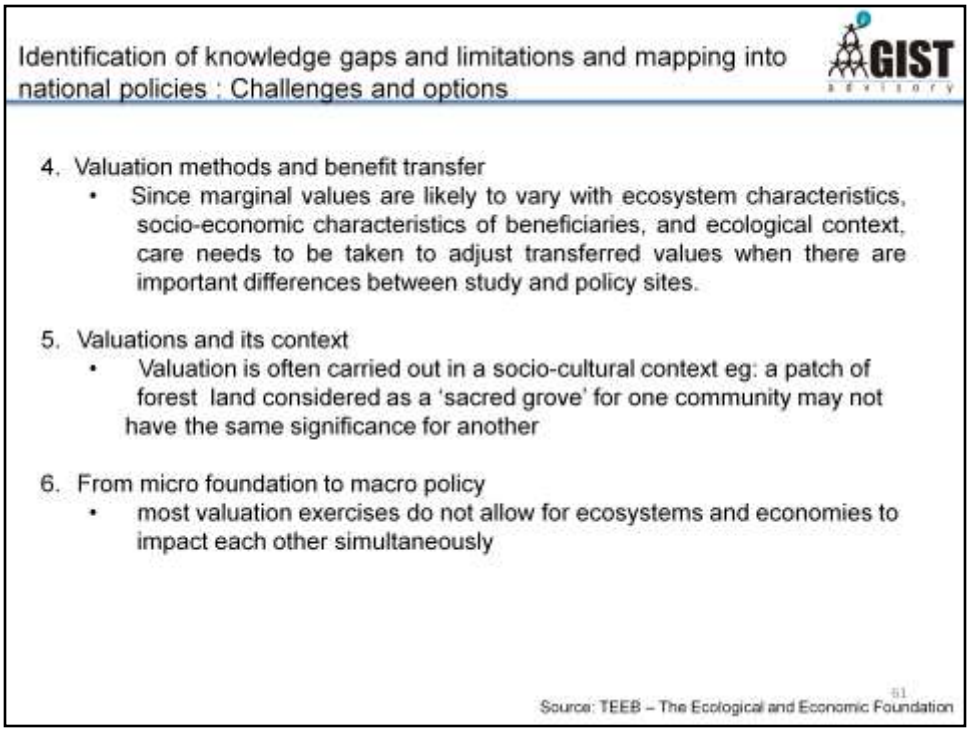
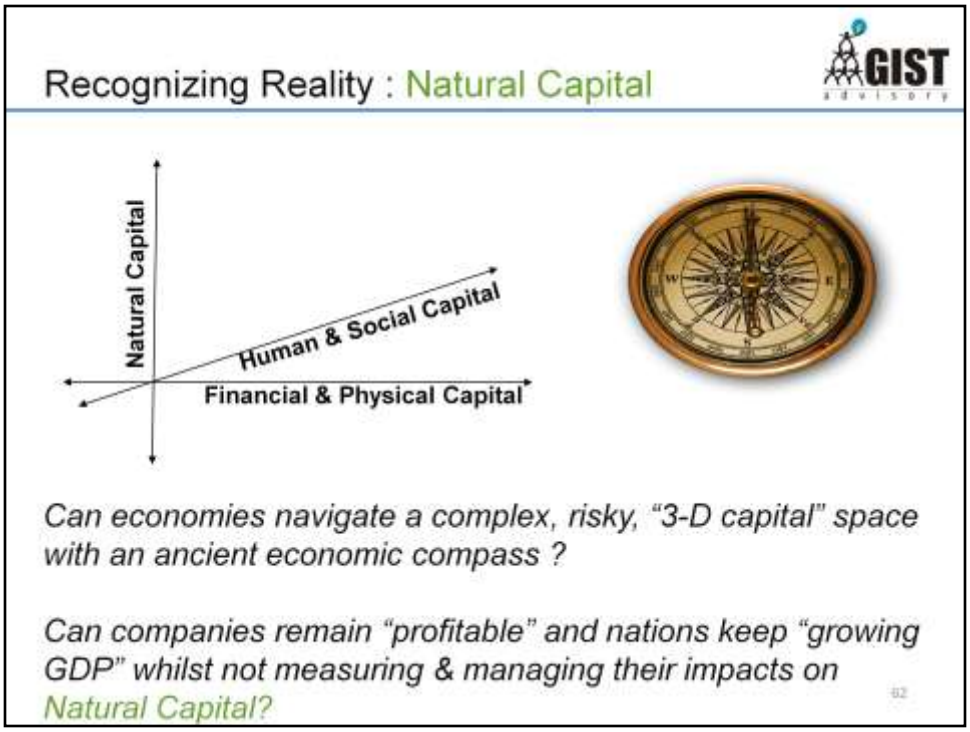


- Finally, there are any number of opportunities to identify and keep closing the ecology and valuation gaps, both big and small.
- Money is available to support this research.



- However, the mechanics of disseminating the numbers are not well supported.



- We need to do this; we have to do this.
- The fact that we do not put natural capital on our balance sheets is a huge mistake. TEEB was reporting on natural capital. The methodology is consistent. Natural capital valuation is so location specific and there are so many different strategies. It is important to include it all. Make sure you follow the thinking process. If you want to eliminate a solution, go ahead just make sure you have a reason. In Germany, the same six step process works. The steps make as much sense in Germany as they do in Indonesia, which speaks to TEEB's community effort.
- GDP is the bad compass. It will tell you about profits but not about the value. You need much more information and that is the direction we must to go.
- I am a firm believer that you cannot manage what you do not measure and right now we are not measuring what is important. Now is as good of a time as any to start measuring.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Seminar 4 Discussion Synthesis

June 23, 2011

This document is a synthesis of important topics and questions discussed during the question and answer period immediately following Mr. Pavan Sukhdev's presentation. Please keep in the mind that the following is only a recap and speaker identities have been removed, except for Mr. Sukhdev. We hope that the following notes and discussion questions will be used as resource to advance further discussions about ecosystem services.

Below you will find a summary of specific key questions and topics that were covered during the Seminar discussion.

Question 1

First, you made a very compelling argument about the difficulty of creating markets with which I think there is misplaced infatuation. Specifically you mentioned the challenges around greenhouse gas emissions and I have never thought of it in those terms. I take it that those challenges will likely be an impediment to a global greenhouse gas emissions market. What is your outlook for the cap and trade regulatory framework as opposed to taxation?

MR. SUKHDEV

- I am a bit of a pessimist when it comes to this process because it is built on putting 192 countries in one room in search of a consensus. It will not work. Imagine asking 192 people what film they want to watch - you will never reach a consensus.
- Reducing Emissions for Deforestation and Forest Degradation (REDD+) is more likely to work because it came from consensus. I think this approach will work in carbon markets.
- If goods and services are ranked and rated based on their carbon content and can get the stamp of carbon efficiency, then this can start attracting interest from corporations. We need to show that carbon efficiency will have returns.
- If PUMA wants to sell "carbon free shoes," they have to offset US $45 million worth of carbon. In my opinion, something like this is more likely to work. The seeds of this are beginning to happen but it is not working because there are too many vested interests that are impeding its progress.

Question 2

We have talked about the notion of creating corporations as agents conscious of externalities. Is your vision to do this by 2020?

MR. SUKHDEV

- Not entirely, getting corporations to disclose externalities is only one way. PUMA is demonstrating that it is possible, but that does not mean that they will actually commit to reducing or eliminating those externalities. Today, the chief executive officer (CEO) of PUMA is doing it because he feels like it. Tomorrow, he will need to be told that he has to do it by the international community – that is what will make the difference.
- We need to work with accounting bodies to require this kind of reporting and to require companies to do what is in the interest of the public. The Institute of Chartered Accountants in England and Wales (ICAEW) has a charter that tells participants to go with the public interest even if it conflicts with shareholder interest.
- The ability to leverage without real control needs to change. Right now, we do not have any real limits. Today it is up to markets and that means banks (who are lending more and doing more derivatives to compete to make profits). We take the risk off our balance sheets and give it to someone else. The balance sheet is not a resting place for debt; it is a passageway for debt so there is no "pain." Through the modern financial system, we give infinite leverage on one condition: the market will catch you – but it will not.
- Market research creates product demand. We work on human frailty and insecurities. Yes, you need a car in California to travel, but do you need a Porsche or an Aston Martin? Marketing makes you want it. Is it ethical to play on someone's insecurities and make them think that they need the nice car? There is no way to control this.
- An advertisement is an inducement. I can say whatever I like to get you to buy it and create demand. This is another huge issue that needs addressing. These are key changes that cannot happen on their own. It will take increased regulation and consumer knowledge. Consumers need to participate, which in turn, requires a lot of education.

- The playing field is not equal. If you were a businessperson, why would you enter the renewable energy business when we give a trillion dollars' worth of subsidies to the oil industry? It would not make sense from a business perspective.

Question 3

When it comes to certification, we have not seen a price premium for Forest Stewardship Council (FSC) wood to the same extent we have seen for grass feed beef or sustainably harvested fish. I am interested in the diagram from slide 13. Payment for ecosystem services (PES) was separate from the markets in the capturing value bubble. Do you think there are enough public funds for REDD + to be significant and adequate? Or are the potential market interests driving it?

MR. SUKHDEV

- REDD+ will not work with just a few leading nations addressing and allocating reserves from the fund. Just as you need benefits on the sales side, you need the nations, states, and communities to benefit as well. You need criterion to sell and receive REDD+.
- In addition, carbon needs to be included. By creating green carbon, you could generate interest on the larger scale. It needs countries that are willing to pay and constituents who are willing to participate. This would benefit REDD+ and we are close. I do not think we are far away because we have the willingness to pay on top and bottom levels.
- Your other question is also interesting. The volume of FSC certified products is going up and up and maybe it is a result of limited price differentiation. FSC is delivering in terms of volume not in terms of unit price. The white stork example I presented exemplifies the opposite. The white stork rice delivers in price but very little in terms of area protected. I do not see the small price increase as a bad thing; it is a market share issue.

Question 4

You started your talk today by introducing yourself as a capitalist. Throughout the presentation, you mentioned the different scales at which ecosystem services need evaluations. I am struggling to reconcile the way in which the place and ecosystem specific evaluations get to a high scale with green accounting across countries. Can you speak further on how to reconcile the tangible local level to the scale at which you are addressing with this new paradigm?

MR. SUKHDEV

- There are issues with the conversion to the policy level, but it is taking place. When national accounting exists, say for Indonesia, water quality and soil erosion will be included when reporting on deforestation.
- In India, there are agencies left over from the British Empire who are charged with data collection. We wanted to calculate flood loss as compared to deforestation. In 55 years, we were the first people to ask the agencies for their data! You see that it is likely that the information already exists; we just need to do something with it. If you look at ecosystem services and the forest services lost during deforestation on a local level, you can then extrapolate to the economic level and get an image for nation as a whole. Certainly, there are not measurements like this everywhere in India, but there were enough to get a good picture for the nation.
- The fact that InVEST exists can help create a national picture. There is a tendency to start believing in and managing what you measure, so it is important to measure on the ground at the local level.
- The Economics of Ecosystem and biodiversity (TEEB) studies are supposed to ensure enough data exists so that the national accounting framework has enough data to do proper calculations.

Question 5

The kind of approach you are talking about is one that demands poor people to submit to an accounting system that is inherently modern in order to determine how they derive livelihood form nature. This will lead to them being "managed." Poor people who are traditionally not well represented are not measured or accounted for - this kind of empire governs through creating standardized people. Have you reflected on that?

MR. SUKHDEV

- I have mixed feelings and I assure you it is not something we ignore. There are impacts to the poor that we need to capture and asking them may be the only way. A great deal of their income comes from nature indirectly or directly. In Brazil, Indonesia, and India, three different estimates said that typically 10-20% of gross domestic product (GDP) is dependent on ecosystem services. In reality if you look at those populations and what they are earning, the total mix of villagers and forest dwellers derive 50-90% of their income directly from nature. We need to get the calculations at the state and community level to show the importance of nature. That requires meeting with elders and asking what the relative importance of ecosystem services are for their communities.

You can involve the local community to estimate their values. It is difficult, nothing I have shown is easy, these are complex problems and you need to address them.

- We did have a proposal to do this, but it was rejected for not being big enough and not having enough science. The whole idea of measuring poor GDP, involving them, using it, and making policy changes to see its success, has to be the way forward. Sadly, at a national level, the aggregate is fine, but poor countries know that aggregate GDP is wrong. The sooner we start funding research in this arena, doing the research on the ground, and helping countries build up the information, the sooner we can move forward.

Question 6

Your new book uses 2020 as the target year. What factors make you think that it is the right timeframe for changing corporations?

MR. SUKHDEV

- The argument behind the book is that we have a lot to change in the next ten years. TEEB came along and my time has not been mine for the last three years; now, I think we have another ten years to make changes, make advertising ethical, and replace antiquated profit obsession with a resource conservation obsession. I think we have ten years to get this all going and Corporation 2020 captures it.

Question 7

At one point, you mentioned the changes that need to occur in our education system and about getting this information into textbooks. It seems to me that we need to change how we teach economists since they are shaping policy. They are the same ones from forever. How do you change that mindset while our business schools keep turning out the same graduates?

MR. SUKHDEV

- The leaders are also getting wise. There is recognition that the old thinking is no longer working. We have been through four recessions recently and they are all the same version of the other. If you look at some of the recent stuff coming out of the World Bank, which is a complicated beast, you can see the shift happening. Within the World Bank, there are enough voices of reason. They support old thinking, but within that, there is some new thinking going on:
    - In TEEB, we incorporated information from Wealth of Nations to create some decision-making criteria for lending.
    - The International Development Bank asked me to develop a strategy that looks at social capital. They want to allocate a chunk of their lending pot to developing a green economy.
- In general, we use whatever means we can. We keep feeding people who are positively inclined to accept, and that is all you can do.
- With regard to education, it is a slow course, but it has to start now. I am pleased to announce that Yale is starting a TEEB course next semester with an executive level TEEB course to come later. The course is to be offered as a bridge course between the business, management, and environment schools.

Question 8

Increasingly, China is outpacing the traditional banks in terms of financing and resource development, particularly in developing countries. What points of potential influence do you see there? China seems to be getting more progressive in incorporating these concepts at home, but less so in their work in Africa and South America.

MR. SUKHDEV

- I recommend thinking of China as two systems at work simultaneously. GDP drives the brown economy. If GDP stops growing, China could suffer chronic unemployment, which is political death.
- At the same time, China needs to create a different game, which is the green economy. Fourteen million Chinese have solar water heaters; they are. China is 60% of the solar water heater market and they will sweep the marketplace because they have economies of scale of which we cannot even dream. I am sure they will think of technologies that will help them. Think of China as 1.4 billion people on a speeding train that is about to crash and at once, all of them jump to a slower moving train that is headed to a better place. The slower moving train is the green economy.
- Resource extraction is part of the brown economy (the speeding train), some places it has aspects of green. China is in a resource scramble; they are that largest purchaser of land in other places. They are developing a monopoly on magnets. In a way, this is smart for them because they have such economies of scale, but there are also political downfalls to this land grab. This is an important philosophical question – how did the British Empire give way to the American Empire so seamlessly? China wants to do that.

Question 9

When you identified opportunities, you highlighted the need to support how we use ecosystem services and the need to develop the ability of policy-makers to use ecosystem services valuation. What is the need and how do we move in the direction to support decision-makers to use this type of information?

MR. SUKHDEV

- We need to get national accounting in the same framework, but we also need it at the ground level. How does a province work towards getting a value for preserving ecosystem services? How does it work with the finance ministry at a national level? A lot of state-centered or province–centered appreciation has to happen.
- There is also a lot of room to solve local problems with local solutions. Maintaining a swamp as a cost-effective natural sewage treatment facility is a domestic example that would not have happened if the economics were not highlighted and brought to the table. Today I think you will find many people desperately trying to get numbers to justify next year's budget.
- Capacity building is the biggest opportunity. How do you provide respectable information to help decision-making? A lot needs to happen to build capacity.

Question 10

When you mentioned TEEB in Brazil, who would you work with in the country? There is a lot happening in Brazil with REDD+ and in the state of Acre, their laws stipulate payments for ecosystem services. What are they hoping to get out of it?

MR. SUKHDEV

- Interest for a TEEB-Brazil came from the national level because they knew they needed to display it nationally to gain support. São Paulo is starting, Amazonas now wants to go ahead with it, Tocantins also, and as of two days ago, Rio de Janeiro is interested as well.
- TEEB for business has strong backers in Brazil; Ventura and Vale are interested. Brazil is a good example, but I am worried about the complexities. They will need to coordinate the effort to avoid having different states using different templates. It will need to be connected at the national level. There is a need for strong coordination.

Question 11

Ecosystem services come in many different flavors some of which are quantitative others are qualitative. How can we empower decision-makers to deal with the asymmetry as it lends itself to a broader determination of value? How do you to manage that complexity?

MR. SUKHDEV

- The complexity is there. Some ecosystem services are "easier" to value than others are, but you also have additional dimension such as the scales at which they operate. For instance, you may have a coral reef that provides sustenance for the local community and therefore has high local value. The same coral reef may have value nationally because it brings tourism to the country. It then also has international value because tourists travel from all over the world to get to the reef.
- The local community can address the local need. We can help by defining what needs to happen. We need to define the benefits that flow at the local level and connect them to the national level. We need to escalate scales of understanding otherwise, we are not optimizing the potential. You need to do what you can to empower people so they can push along the axes (horizontal and vertical).
- REDD+ will not succeed as a pure carbon scheme or a pure forestry scheme. It will not deliver enough value unless it operates on a multi-dimensional basis. It needs to have an understanding that there are different levels of value (local, national, etc.). Agriculture surrounds the forest and it is silly to worry about what happens in the forest and not care what happens right next door. REDD+ needs to utilize an integrated landscape approach. Forests provide many other services besides carbon sequestration. You need to make sure the legal architecture is strong enough to attach these other things to REDD+. There is no option but to recognize the matrix of the layers.

Question 12

Do you see any opportunity from the current European debt crisis to leverage those countries to encourage transparent accounting?

MR. SUKHDEV

- We derailed the report to allow people to understand the linkage between the recessions. Why do you want an economy that is missing natural capital and lacks complete accounting? Our current style of an economy increases the risk of climate change and does not improve wellbeing. By definition, the only viable economy is the green economy.
- The political mandate to invest is there and it has to be in greening the global economy. Korea invested in greening their economy and so did China, but few others rose to the challenge. Europe said it had already done it and the U.S. invested only minimally. Out of US $2.5 trillion of investment, less than US $450 billion went towards developing a green economy. From our estimates, nearly double that investment is needed to make any change.

Question 13

When thinking about TEEB's strategy and its diffusion, I think of it as a viral strategy, but not in the internet sense. With TEEB, you created five different reports for different sectors. You created the DNA and now you want it to explode out that way. How will it be possible to take these ideas and infect the institutions you need to infect? You have a good list, but how do you do it?

MR. SUKHDEV

- That is a perfect description. That is what we have done; we have created a virus. The last types of accounting came out of the UK. We created a demand for new accounting legislation. We provided packets of information to the early adopters and in turn, others follow by taking the ideas. We have gone from push factor to pull factor.
- Two people have put together ideas for and TEEB-Agriculture, which is necessary. India and Georgia need support for a business TEEB.
- There is clearly huge potential impact for those interested in funding this work. There is now a TEEB secretariat in Geneva to help keep this community going. Hopefully it can act as an honest broker because TEEB is a public good.

Question 14

What about global consulting firms? Are they a channel?

MR. SUKHDEV

- Yes, two companies in particular are executing studies. PricewaterhouseCoopers (PwC) has done carbon calculations and True Cost has done fresh water calculations.
- This diffusion is happening on the business side as well, which we should encourage. Deloitte is another company, although they are a little behind PwC and True Cost.
- We are providing the innovation and the ideas and they are putting together the spreadsheets.

Question 15

What is the insurance value of the TEEB approach for insurance and reinsurance agencies interested in accounting methods? For instance, FEMA is now considering natural capital in their accounting.

MR. SUKHDEV

- I think this is interesting. Regulation does not point out the problems.
- If you look at the spill in the Gulf of Mexico, there was no such thing as an ecological risk calculation. BP posed a big risk. In other situations, we conduct risk calculation, but in these types of scenarios, companies do not conduct the typical risk assessment.
- I think that it is important that insurers start asking for this type of information. They should start to ask for assessments of ecological risk. What are the dependencies on a long-term basis for managing risks? Risks of water scarcity or phosphorus scarcity? There is not enough of this going on now, but it should move in that direction soon.
- The WeatherBill focuses on providing insurance for those in areas where the risk from weather and/or climate change is high.

Question 16

What do you think are the most effective mechanisms for non-market ecosystem services?

PARTICIPANT

- Up to now, the conservation community has predominantly invested in preservation activities. At a minimum, there is leakage to climate change and other areas of scale. Now we are beginning to grapple with transforming markets through certification mechanisms. The effort aims to combine non-market values with eco-labeling. It is really in its infancy and PES is a long ways away from satisfying it.

PARTICIPANT

- Part of the solution, in my mind, is to transition out of the preservationist view and work in a way that creates working landscapes where people can live. The land trust community has been pitching this idea the U.S.
- I work in urban landscapes, which are often considered dead zones for environmental attributes. Rio de Janeiro is in the process of redeveloping 45,000 hectares within its city boundaries. They have been considered dead zones and by including people in the equation, you start to develop cultural, spiritual, and recreational values. Those are not the only non-market values we are talking about either. It comes with an enormous amount of effort. People do not always share the same values and you need to empower those communities to communicate them.

PARTICIPANT

- Not an answer but my observation is that many of the cases offered as examples are bilateral cases. Take drinking water, which is a commodity and a natural resource. Sedimentation can make life difficult for a water utility in terms of reservoir management. There has been action, but so far, it has been geographically specific or when a utility has been forward thinking. There are some examples, but not many. Why does this not happen more frequently?
- Yesterday someone from U.S. Forest Service offered to put a fee on all water usage in California. This fee would then generate a pot of money to support upstream processes and improve stream and river health. A small fee on all water users in California would generate a lot of money.

MR. SUKHDEV

- That is not a new idea. In Japan for instance, they have almost 60% forest cover and a forest tax to manage it. The forest is too old and too weak to support sustainable logging and the forest needs maintenance. Through dialogue with the community, they established a local tax to pay for the forest's upkeep and maintenance. As a culture, they believe this is a necessity.

PARTICIPANT

- There is potential to connect people to their natural resource base. You can be a community like a fishery where institutions emerge to protect the resource. They agree to leave fish in the water because it is money in the bank for them in the future. You have many urban poor who experience natural resources but do not make the connection. If you bring business to work together with the community, there is so much potential.

Question 17

What is motivating corporations? Economists have always said that innovation and technology will solve problems. Is there a limit to innovation? Will the cost finally get too high? Are some companies just doing it because it is a good thing to do, while some are just doing it to lead the pack? What is that motivating piece? That piece still gets me.

PARTICIPANT

- Companies are starting to worry about the sustainability of their supplies either because they have a stake in a long-term resource (logging) or because they need the source immediately (water and Coca Cola). As they learn about it, the companies get smarter.

Question 18

What kinds of internal situation logic of corporations are out there? Where are the promising places to look for the initial adoptions? What sections are more vulnerable to this viral infection?

MR. SUKHDEV

- This is really the central question of "where can we drive change?" PUMA made a big splash by being the first to map out their externalities. Similarly, Nestlé is pulling the plug on spending contracts. Our general concern is that this is too much of an evangelical effort that few people are doing the right thing. It takes time. We need to create that fabric of change.
- At one level, you have a gutsy CEO dropping the leading palm oil producer because something clicked - good old shame. The dinosaur corporation needs to get out and we need to bring in the nimble mammal corporation.
- The Equator Principles were created through activism and irritation. Every week there would be some new nongovernment organization (NGO) asking for an investment. This represented risk and the Equator Principles were developed as a way to deal with the risk.
- FSC certification is consumer-driven. If you go back to the origin, it seems that public pressure drove the change. In addition to the public and consumer pressures, there is a leadership component. Leadership responds and the response may not be favorable, but that no longer seems to be the case.
- Consumers are also changing. They are not satisfied by price. Now, they want to know from whom they are buying, what the social and environmental implications are, etc.
- This next generation is part of it. They are amazing and will be a huge driver.

Seminar

5

Ecosystem Services in Practice:

Market-Based ES— From Theory to Application

Speaker

Adam Davis · Dave Batker · Dr. Ben Guillon · Ricardo Bayon

GORDON AND BETTY MOORE FOUNDATION

Ecosystem Services in Practice: From Theory to Application

Introduction and Conclusion by Adam Davis, Solano Partners, Inc.

INTRODUCTION

The fifth seminar in this series, moving from theory to practice, examines new ways in which payments are being targeted at conservation and restoration objectives. As scientifically verifiable measures of water-, carbon-, and biodiversity-related benefits improve, they are increasingly being aligned with payments to landowners and land managers to create incentives for desired outcomes.

This seminar explores three innovative examples of market-based ecosystem services approaches that address quite disparate issues, but have in common the use of a cutting-edge measure of ecosystem performance as the basis for payment. These examples come from Brazil, Malaysia, and the state of Washington in the United States, and describe forest protection and restoration activities as well as a broad suite of watershed restoration actions for salmon habitat.

Market mechanisms that reward land managers have improved in reach and sophistication over the past decade. Quantitative assessment of the ecosystem services that result from specific protection and restoration actions are now the basis of credits in wetland, stream, water quality, and endangered species habitat markets in the United States. As a result, significant private and institutional investors are now able to recognize compensatory mitigation credits as an asset class, and the pool of capital available for conservation is expanding.

The stories related in this seminar, however, are not about the most developed and predictable of the environmental markets. Rather, they are about pioneering efforts to apply what is known about measurements of carbon, water, and biodiversity benefits to new forms of conservation activity. These new efforts broaden the application of ecosystem service theory beyond specific regulatory-driven compliance markets to address other, more complex buyer motivations, political structures, and the needs of conservation projects that have multiple objectives.

The first case presented here describes an innovative public financing structure known as a watershed investment district (WID). The WID mechanism essentially coordinates and integrates public funding to reduce conflict and unintended consequences from individual restoration and infrastructure projects.

The watershed of the Green and Duwamish rivers in King County, Washington, is home to over 600,000 people, and the rivers continue to support one of the largest runs of endangered Puget Sound chinook salmon remaining anywhere, despite tremendous disruption and ongoing development pressure. It is also managed by a confusing and overlapping set of jurisdictions that includes 16 cities, the County, the Port of Seattle, and various state and federal agencies.

This case study, presented by David Batker, executive director of the Tacoma-based non-profit, Earth Economics, provides an example of the use of ecosystem services–related insights and metrics to organize funding mechanisms at a significant scale. These mechanisms provided decision-makers with a clearer window into the benefits and costs of various management alternatives, and enabled them to overcome political and organizational boundaries to create an ecosystem service approach to watershed restoration.

The second case is described by Dr. Ben Guillon, who served as manager of mitigation investment and policy for New Forests, a fund and account manager for timberland and associated environmental markets headquartered in Sydney, Australia.

New Forests' Eco Products Fund has committed US $10 million to the Wildlife Habitat Conservation Bank located in the Malaysian state of Sabah, in the northeast region of the island of Borneo. The investment thesis here depends on the sale of voluntary biodiversity conservation certificates that represent certified offsets for impacts resulting from palm oil production or through the sale of voluntary carbon credits from REDD-compliant activities.

Sabah's forests were heavily logged in the 1980s and 1990s, but the forest is now under much more direct threat from the expansion of palm oil plantations. If successful, the "biobank" model for rainforest conservation will use private finance to enable a link between

agricultural commodity production and forest conservation through the sale and purchase of biodiversity credits that respond to the needs of the oil palm industry to “green” its supply chain.

The third and final example comes from the Brazilian states of Rondônia and Mato Grosso , and represents one of the largest projects to date under the international Reduced Emissions from Deforestation and Forest Degradation (REDD and REDD+) incentive programs enabled by the United Nations Framework Convention on Climate Change.[1] It involves a management plan for indigenous land belonging to the Suruí people, and describes a structure to offer financial support based on the exchange of carbon credits that can be generated through REDD+ compliance activities.

This case is presented by Ricardo Bayon, a partner and co-founder at New York–based Eko Asset Management Partners, a specialized investment and advisory firm focused on monetizing environmental assets. Eko Asset Management Partners is interested in investing in Suruí carbon that would be generated under an all-inclusive 50-year strategic plan. The project would reward the Suruí for more sustainable land-use practices that promote and sustain community and environmental health.

While the case studies presented here necessarily reflect the complex risks inherent in all pioneering efforts, they also provide important insights to the community of scholars, practitioners, and potential investors interested in the value proposition at the core of the ecosystem services theory. We present them here for the lessons they offer in order to inform future efforts.

[1] REDD is a financial mechanism that creates incentives for countries and landowners to limit the conversion of forests into other land uses by valuing the carbon sequestered in the trees. In some cases, carbon offsets can then be produced through REDD and sold on the carbon markets. REDD+ is a variation of REDD; it goes beyond REDD to includes forest carbon stock enhancement, sustainable management, and conservation.

CASE STUDY: GREEN/DUWAMISH RIVER AND CENTRAL PUGET SOUND WATERSHED

by David Batker, Earth Economics

Overview

The Green/Duwamish River and Central Puget Sound watershed is located in King County, Washington State, and includes Seattle and 15 other cities. There are over 600,000 residents within the watershed. It has the highest assessed property value of any in the state and is a major national manufacturing, transportation, and shipping area. The upper watershed is owned by private timber companies and Tacoma Water, providing forest-sourced and filtered water for the cities of Tacoma, Renton, and others. The Middle Green subwatershed is zoned agricultural and residential, with major transportation corridors. The Lower Green is highly industrialized, terminating in estuary and the Port of Seattle.

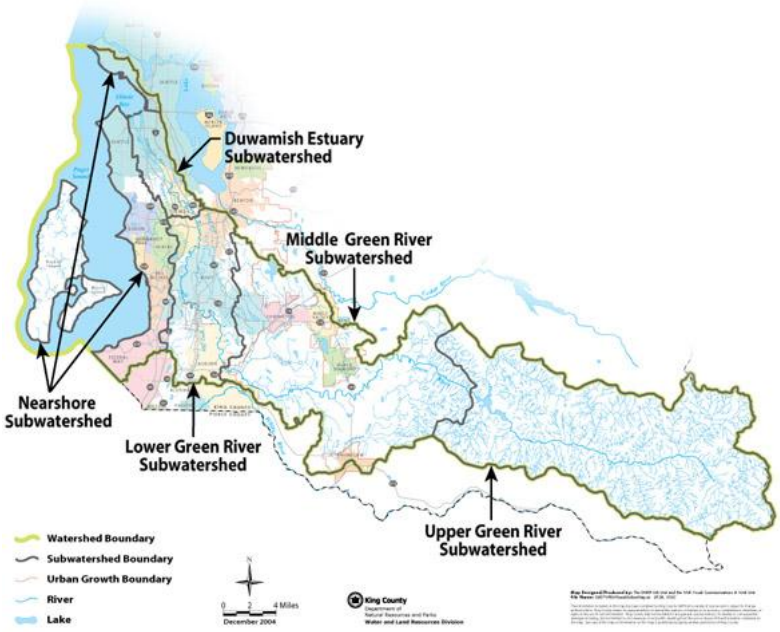

Figure 9: Map of King County Watersheds. *Source: King County 2010.*

The Green River is part of the federal Endangered Species Act (ESA) habitat listing for Puget Sound chinook salmon. Despite tremendous disruption, this river has one of the largest chinook runs in the Puget Sound basin. Once suggested as a "write-off zone" for wild salmon, the Green River watershed may actually lead the way for adopting ecological economics and ecosystem services as an approach to restoring salmon and establishing new funding mechanisms for restoring natural capital on a large scale. This approach has cut through polarized political barriers to implement restoration projects.

The Green/Duwamish River and Central Puget Sound (WRIA 9) Watershed Ecosystem Forum represents the 16 cities, King County, the Port of Seattle, Boeing, the Army Corps of Engineers, Washington Department of Fish and Wildlife, Washington State Department of Natural Resources, Washington State Department of Ecology, the King Conservation District, and several other citizen, business, and environmental entities. Over a period of six years, Earth Economics and the Forum worked together to develop viable funding mechanisms and an ecosystem service approach to watershed restoration. The approach included: 1) examining the provisioning, beneficiaries, and impairments of ecosystem services in the Green River watershed, such as salmon habitat, flood protection, and recreation; 2) valuing those ecosystem services using benefit transfer methodology; and 3) identifying funding mechanisms of sufficient scale to protect, restore, and enhance natural capital.

Discussion of Outcomes

On May 13, 2010, the 70-member representative Forum took two remarkable steps:

1) The Forum voted unanimously to pursue US $300 million in funding over the next ten years to create the world's first salmon restoration funding mechanism of sufficient size to fully fund a salmon habitat plan.
2) The Forum determined to advance an integrated approach to investing in stormwater management, flood protection, and salmon habitat restoration to improve the health of the Green/Duwamish River and Central Puget Sound watershed.

At the core of this case study is the need to rationalize major expenditures within the watershed to provide greater services at far lower cost. By coordinating storm water, flood, potable water and salmon restoration investments, goals for recharging groundwater, restoring salmon, securing water supply and flood protection can be achieved. Securing levee setbacks in the transition zone provides greater salmon benefits and can create parks, increasing public benefits and private property values.

Earth Economics analysis demonstrated that single-purpose approaches to watershed management often create "infrastructure conflict," where one infrastructure investment frustrates the single-purpose goals of other infrastructure investments. For example, the cities in the Green River watershed have built stormwater systems to direct water more quickly into creeks and the river system. This has increased peak flows and flood damage, including damage to levees. Both higher levees and current stormwater systems have contributed to a reduction in water quality, damaging Puget Sound.

Out of this integrated approach, we developed the concept of a new institutional framework and funding mechanism in Washington State, called the WID. In late 2010, the Forum began reaching out to other watershed resource inventory areas (WRIAs) in the Puget Sound and across the state. A formal cross-WRIA working group was established in 2011, and work drafting the proposed legislation was led and completed by King County. King and other counties will be pursuing the legislation in the 2013 legislative session. The creation of a WID enables watershed-specific funding mechanisms selected from a large suite of possibilities, including private and public payment for ecosystem services (PES) schemes.

SUCCESSFUL ELEMENTS

- Conducting an ecosystem service valuation of 12 ecosystem services for the watershed, showed that the group has a large set of capital assets worthy of restoration and maintenance.
- Writing the award-winning economics chapter of the WRIA 9 Salmon Habitat Plan set out goals for "solutions at the scale of the problem," and demonstrated the need for dependable, sufficient, fair, and rational funding mechanisms.
- Performing economic analysis for specific salmon restoration projects that included ecosystem service co-benefits resulted in unanimous approval of projects worth millions of dollars, "dirt moved," and salmon restoration projects completed. This pragmatic application strengthened and unified the commitment of public and private participants to a more comprehensive solution.
- Provisioning assets, beneficiaries, and impairments — the three ingredients needed to structure a sustainable funding mechanism — were mapped.
- A two-year review of 25 potential funding mechanisms to achieve the target of a US $300 million funding mechanism was an arduous but outstandingly productive process involving public and private stakeholders.
- Agreement was reached to create a WID, to be funded by several taxes: first an incremental property tax, then, as mapping and modeling allows, payments from beneficiaries and impairers, with investments back into the provisioning assets. Reports outline the details of the 25 proposed mechanisms, the top eight, and final three selected.
- In 2011, legislation was drafted to allow for WID creation in watersheds statewide by voters within the watersheds.

ENABLING CONDITIONS

- Having a regulatory driver (ESA)
- Having all significant stakeholders at the table
- Initial valuation of ecosystem services (benefit transfer), which convinced all stakeholders that natural capital within the watershed is a tremendous capital asset, which enables economic development
- Having a completed project-level case study to illustrate success in securing funding and consensus using ecosystem service framework
- Having bold, politically savvy elected leaders, both Republicans and Democrats
- Having a few bold bureaucrats who became convinced and were willing to propose new ideas
- Having enlightened and forward-thinking private industry actors who were willing to consider multiple benefits and helped corral into collaboration business leaders who were more skeptical
- Having a very competent implementation and management team in King County that embraced ecological economic analysis, handled funding responsibly, and implemented salmon restoration projects effectively

Textbox 3: Enabling Conditions.

Enabling Conditions

The WRIA 9 Salmon Habitat Plan outlines US $300 million in projects required to secure viable and healthy chinook salmon populations to meet ESA targets. Grants cannot supply this scale of funding. The Forum identified the funding needs, and Earth Economics assisted in developing a suite of specific funding mechanisms that would raise US $300 million within 10 or 20 years, with the jurisdictional framework to house a new WID.

WRIA 9 elected officials, Democrats and Republicans, spent one year recruiting legislators and other WRIAs to support the WID. The fact that the WID moves funding from downstream beneficiary cities such as Seattle into up-stream areas (which are more conservative and resource-dependent, and have lower household incomes), helped secure rural, conservative community support. To date, legislation has been drafted and counties and legislators have been brought on board as a result of the effort of elected officials committed to the WID proposal.

CHALLENGES

Challenges have been primarily the time it takes to communicate with and respond to all the questions and concerns of both public and private stakeholders. The vetting of funding mechanisms took two years, but was thorough. It secured the support of Democrats and Republicans, the Master Builder's Association and environmental groups, businesses and federal agencies. A lesser challenge is that King County and WRIA 9 have strong ownership, which has created a good core of support but set a slow and conservative pace for the pursuit of the WID legislation. Outreach to neighboring watersheds from Olympia to Everett has been strong, but statewide it has been slow, due to concerns about introducing the legislation in tough budget times, although there is great applicability in both rural and urban watersheds.

For the intervention of the nonprofit community as catalysts in the process, funding to enable more time to work with stakeholders, rural and urban, public and private actors is crucial, to build knowledge, commitment, and momentum. It seems that initial funding is best provided by foundations, and as the benefits are perceived, cities and counties will contract independently for the services, with nonprofits or with consulting companies as they expand into this field.

In this case, the intervention by Earth Economics was first enabled by grants from the Russell Family Foundation and Bullitt Foundation in 2004; then WRIA 9, King County, the King Conservation District, and other public funding was provided on a contract basis, with some additional gap funding support from foundations. In 2010, after contract funding for identifying the funding mechanisms and structure of the WID had been completed, the Gordon and Betty Moore Foundation provided key bridge funding when requests for briefings and information subsequently ballooned statewide.

LESSONS LEARNED

Solving the problem of how to secure funding at the scale required was an early goal. The first step toward success was identifying the key ecosystem services for the watershed, including salmon habitat, flood protection, and drinking water. By answering the concerns of decision-makers quickly and thoroughly, and communicating in both ecological and economic languages, we were able to engage political leaders, agency staff, and the non-governmental organization (NGO) community. Private and public partners were increasingly unified around the economic efficiency of an ecosystem service approach that could establish a permanent and sufficient funding mechanism for natural capital restoration and maintenance.

SIGNIFICANT OPPORTUNITIES

- Release of an ecosystem service appraisal tool, SERVES (simple effective resource for valuing ecosystem services), to increase accessibility for showing the value of watershed-based PES systems
- Capacity for outreach to states and counties ripe for implementation of WIDs
- National accounting standards improvements that include ecosystem services
- Modification of national benefit/cost analysis requirements to include the value of ecosystem services
- A guidebook for applying ecosystem service analysis, valuation and PES structuring

Textbox 4: Significant Opportunities.

Success was secured by gaining approval and funding for specific salmon restoration projects, and by the implementation of those projects, which provided additional ecosystem service benefits. Salmon habitat was improved in the highest-priority areas (transition zone). Greater funding was secured through traditional grants, which was a success but clearly seen as insufficient to achieve ecological goals. This unity was made possible by the project's multiple benefits, including salmon restoration, flood protection, stormwater conveyance, water quality, parks, and property values.

Moving Forward

The WID needs to be passed into state law. The application to other watersheds has already begun with the rural Nisqually Watershed (WRIA 12) and several others. The funding mechanism in WRIA 9 will reflect the economic prowess of an urban watershed and be focused on the population size, the industrial beneficiaries of increased flood protection, and the shift to mapping-based ecosystem service billing. The Nisqually's funding mechanism will be focused on Tacoma Power, which owns a dam in the watershed and benefits from sediment reduction, and the city of Olympia, which draws its water supply from the Nisqually basin, as well as a small property tax so that every citizen contributes to the restoration of the watershed's natural capital. Every WID will have a tailored suite of funding mechanisms that depend on its specific ecological, economic, and political conditions.

The WID must be complemented by other institutions, both public and private. Earth Economics, with the Washington State Department of Natural Resources, is developing two PES schemes involving private actors in the Nisqually (rural) and Snohomish (urban) watersheds. Overall public funding for watersheds in Washington State will be derived from the four counties that hold most of the state's income.

This means there is a need for meta-institutions to provide funding across the state. The Puget Sound Partnership (PSP), one such institution, still needs a funding mechanism. Earth Economics is engaged with PSP to develop funding mechanisms that are complementary to the WID and allow funding of work in rural watersheds. A state-level mechanism is also needed, and discussions are underway with the State Department of Natural Resources and Department of Ecology.

Critical to success is understanding the physical nature and distribution of ecosystem services and required enhancements, which determines how well markets or public institutions can embrace PES systems. Markets perform best where excludable goods are produced; a public utility structure is better where non-excludable services are provided. How these production and distribution systems fit with existing land ownership, culture, tax jurisdictions, and institutions is critical to the design of watershed-based ecosystem service funding mechanisms.

There is great promise for expanding this model at the watershed scale nationally and internationally. In regard to flood protection, drinking water, floodplain function reduction, hazard reduction, and mitigation, the idea of a watershed-scale institution charged with maintaining and enhancing natural capital is increasingly well-received. A strategy is needed for moving this work to a national and global scale.

In addition, there are complementary efforts that would greatly strengthen the application and effectiveness of PES systems at the watershed level. These include improving national accounting standards to include potable water provisioning and quality, flood protection, and habitat. Improvements to traditional benefit-cost analysis (required by all federal, state, and local agencies) to include the value of ecosystem services would shift billions of dollars from less-effective "hard" solutions, such as higher levees, to more resilient solutions that provide greater ecosystem service benefits, such as moving levees out and expanding the floodplain. There is a significant list of actions that would improve economic decision-making and allocation of private and public resources, enhancing PES schemes and the allocation of capital.

References

WEBSITES

Earth Economics: http://www.eartheconomics.org.
Green/Duwamish and Central Puget Sound Watershed Salmon Conservation and Restoration: http://www.govlink.org/watersheds/9/.

PAPERS

WRIA 9 Watershed Ecosystem Forum. 2010. *Toward implementing the WRIA 9 Salmon Habitat Plan*. Earth Economics. http://www.eartheconomics.org/FileLibrary/file/Reports/Puget%20Sound%20and%20Watersheds/EE_WRIA_9_Salmon_Habitat_May2010.pdf.

———. 2009. *Generating payments for ecosystem services: WRIA 9 funding mechanisms report*. Earth Economics. www.eartheconomics.org/FileLibrary/file/Reports/Puget%20Sound%20and%20Watersheds/WRIA%209_Funding_Mechanisms%20Report_2009.pdf.

POLICY BRIEFS

WRIA 9 Watershed Ecosystem Forum. 2010a. *WRIA 9 (Green/Duwamish River watershed) policy brief #1: Project history*. Earth Economics. http://www.eartheconomics.org/FileLibrary/file/Reports/Puget%20Sound%20and%20Watersheds/WRIA%209%20Policy%20Brief%201%20Project%20History%20v2.0.pdf.

———. 2010b. *WRIA 9 (Green/Duwamish River watershed) policy brief #2: Funding need*. Earth Economics. http://www.eartheconomics.org/FileLibrary/file/Reports/Puget%20Sound%20and%20Watersheds/WRIA%209%20Policy%20Brief%202%20Funding%20Need%20v2%201.pdf.

———. 2010c. *WRIA 9 (Green/Duwamish River watershed) policy brief #3: Flood control district levy increase.* Earth Economics. http://www.eartheconomics.org/FileLibrary/file/Reports/Puget%20Sound%20and%20Watersheds/WRIA%209%20Brief%203%20v2.0.pdf.

———. 2010d. *WRIA 9 (Green/Duwamish River watershed) policy brief #4: Assessment/fee/tax*. Earth Economics. http://www.eartheconomics.org/FileLibrary/file/Reports/Puget%20Sound%20and%20Watersheds/WRIA%209%20Policy%20Brief%204%20Assessment%20Fee%20v2.2.pdf.

———. 2010e. *WRIA 9 (Green/Duwamish River watershed) policy brief #5: Watershed Investment District.* Earth Economics. http://www.eartheconomics.org/FileLibrary/file/Reports/Puget%20Sound%20and%20Watersheds/WRIA%209%20Policy%20Brief%205%20WID%20v2.0.pdf.

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THE MALUA BIOBANK

by Dr. Ben Guillon, WRA Environmental Consultants and New Forests (formerly)

The Malaysian state of Sabah is located in the northeast region of the island of Borneo. It is home to one of the world's most extraordinary assemblages of wildlife species, including the orangutan; the Bornean gibbon; a variety of large cat species, including the clouded leopard; pygmy elephant; the critically endangered Sumatran rhino; sun bear; and 300 species of endemic birds. The forest of Sabah is based on towering dipterocarps that have been the basis of a significant timber industry for decades. Much of the commercial logging is now finished and the timber industry is in substantial decline; today the forest is under much more direct threat from the expansion of palm oil plantations.

The government of Sabah has actively sought innovative solutions to financing forest conservation and transforming its forest estate to a long-term model of sustainable management. It understands the significance of its biodiversity and the option value it provides both to Sabah and to the world. For example, saving and studying the animals, plants, and fungus living in the forest could potentially lead to the discovery of new drugs to treat diseases like cancer. The Malua Wildlife Habitat Conservation Bank creates an incentive for the government of Sabah to forgo revenues from logging licenses and fees though the monetization of the biodiversity harbored in the Malua Forest (Malua Wildlife Habitat Conservation Bank 2010). The idea behind the Malua BioBank is that the forest produces ecosystem services of higher quantity and quality when intact, and therefore its preservation will provide greater value than the benefits derived from the marginal expansion of palm oil plantations.

Figure 10: Map of Malaysia and Indonesia. *The Malua BioBank is located in the Malaysian state of Sabah. The Malaysian state of Sabah is at the northeast tip of the island of Borneo.*

Overview

The Malua BioBank covers 34,000 hectares (80,000 acres) and encompasses the watershed of the Malua River, a tributary of Sabah's longest river, the Kinabatangan. Malua lies within the Heart of Borneo boundary, is surrounded by palm oil estates on two sides, and acts as a critical buffer zone for the pristine Danum Valley conservation area to the south (Brunei Forestry Department 2003). The predominant vegetation type in Malua is lowland dipterocarp forest that has been selectively logged for high-value commercial timber species while retaining its outstandingly high conservation values. The project goals are:

- To restore and protect populations of endangered and protected species in the reserve
- To restore a functioning lowland dipterocarp ecosystem in the reserve
- To create a new model for rainforest conservation, using private finance and linking increasing agricultural commodity production with the expansion of forest conservation through the sale and purchase of biodiversity credits

The Malua BioBank is a joint venture between the Malua BioBank Company — established and wholly owned by the Eco Products Fund (EPF) — and the Sabah state government. The Sabah state government has been supportive of efforts to make the project a commercial success. The Sabah Forestry Department implements the conservation work on the ground, while EPF develops the BioBank's marketing program. The EPF is a private U.S. equity fund that invests primarily in terrestrial carbon markets and wetland and stream mitigation banks in the United States. EPF committed US $10 million to the Malua BioBank in August 2008. [2]

[2] EPF is managed jointly by New Forests and Equator LLC. New Forests (www.newforests.com.au) is a forestry and ecosystem services investment management firm based in Sydney, Australia, with offices in San Francisco and Kota Kinabalu (Malaysia). New Forests manages forest plantations, carbon

The investment thesis of the Malua BioBank is predicated on the increasing need of the palm oil industry to "green" its supply chain. Malaysia and Indonesia are the largest global producers and exporters of palm oil, which is used in a large number of food items and cosmetics, and increasingly as a feedstock for biofuels. The production of palm oil in Malaysia and Indonesia has increased significantly in recent decades, but most often by plantations on lands converted from rainforest to oil palm. The conversion of rainforest has had significant environmental effects, including loss of habitat, destruction of biodiversity (including significant impacts on globally recognized species like the orangutan), and emissions of carbon dioxide from forest destruction.

Figure 11: The Malua BioBank is adjacent to the palm oil frontier. *Source: Sabah Forestry Department.*

Consumers in Europe and the United States are increasingly concerned about the environmental sustainability of palm oil, and are demanding that products containing palm oil be certified as coming from sustainable sources. In response, the Roundtable on Sustainable Palm Oil (RSPO) has been created to incorporate producers, consumers, and NGOs in a process to develop and implement sustainability certification for the supply chain (Roundtable on Sustainable Palm Oil 2009a).

The BioBank was set up to restore and protect the Malua Forest Reserve over a 50-year period, and to finance this through the sale of voluntary biodiversity conservation certificates and/or certified offsets into the palm oil supply chain, or through the sale of voluntary carbon credits from the REDD project. [3] The purchase of biodiversity certificates and offsets from the BioBank would allow end buyers to support forest conservation and support a greening of the supply chain while generating commercial returns for the investor.

The concept of biobanking has been implemented in other parts of the world. In the United States, for example, programs known as mitigation banking and conservation banking, regulated under federal law, require developers to offset impacts to wetland, streams, and endangered species habitat. This is a multibillion-dollar market. Groups like the Business and Biodiversity Offsets Program (BBOP), a program of the international NGO Forest Trends, and the Wildlife Conservation Society have been working systematically with business to standardize and broaden the use of compensatory mitigation of biodiversity impacts.

Discussion of Outcomes

To date, the project has recorded great successes on the conservation front. Logging has been stopped and poaching dramatically reduced. EPF's investment was used to establish new forest checking stations and to equip ranger teams with vehicles, motorbikes, and effective telecommunication systems. The forest department staff is conducting an outreach campaign in the neighboring palm oil plantations. The effect has been a sharp decline in poaching in the Malua Forest. In addition, the forest department, in collaboration with a prominent international NGO, is carrying out a series of research projects, including an inventory of the forest's wildlife and a study on the potential for using cable bridges to re-create connectivity in the canopy for orangutans.

The commercial side of the project, through the sale of biodiversity credits, has been more challenging. [4] Following the global financial crisis, demand for palm oil decreased sharply and palm oil prices plummeted (Aglionby 2008). Several biofuel projects were put on hold or canceled, and the palm oil growers did not see sustainability as the industry's most pressing issue. This clearly illustrates the risk for a project that relies entirely on the voluntary market and industry self-regulation.

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assets, and biodiversity assets in the United States, Australia, New Zealand, and Malaysia. Equator (www.equatorllc.com) is a timberland and environmental asset management firm with offices in New York City and Sao Paolo. In addition to environmental assets managed in the United States via EPF, Equator manages timberland assets in Brazil.

[3] REDD is a financial mechanism that creates incentives for countries and landowners to limit the conversion of forests into other land uses by valuing the carbon sequestered in the trees. In some cases, carbon offsets can then be produced through REDD and sold on the carbon markets.

[4] Credits are individually registered on the Markit Environmental Registry (they were listed on the TZ1 registry prior to its acquisition by Markit). Each credit is fully traceable and can then be transferred to a buyer account. The buyer then has the option to either retire the credit or keep it and resell it at a later date.

Enabling Conditions

The project's conservation success can be traced to the strong partnership between the Malua BioBank and the Sabah government. Sabah's chief minister, the director of forestry, and several local businessmen have demonstrated their personal commitment to conserving the forest, as well as a genuine interest in new approaches to conservation such as REDD and biodiversity certificates. This core group of champions enabled the project to be carried forward in spite of pressure to convert the area to oil palm or timber plantation. On the ground, forestry department staff who had been active in logging the Malua Forest embraced their new mission, as they understood that their jobs were closely tied to the survival of healthy forests. Finally, a strong network of local NGOs provided the project with the much-needed scientific capacity and technical support.

Moving Forward

The main challenge faced by the Malua BioBank is the absence of a clear regulatory framework for biodiversity offsets in Malaysia, as well as the lack of commitment from the palm oil industry. The project was predicated on the development of a voluntary market for biodiversity credits based on self-regulation by the palm oil industry. Indeed, the RSPO announced in 2009 that compensation for impacts to biodiversity was a priority for improving its sustainability certification (Roundtable on Sustainable Palm Oil 2009b).

In the wake of the global financial crisis, however, most palm oil growers are focused on maintaining their profit margins and see sustainability issues as a luxury they cannot afford. Consumers are trying to adapt to the effects of the crisis on their everyday lives, and are less inclined to focus on responsible products and companies. In the absence of these drivers, a voluntary market is very unlikely to start and grow. To address this lack of regulatory framework, the Sabah government has been considering the development of a "no net loss" policy for forests and the use of biodiversity offsets. Malua BioBank is well placed to provide biodiversity offsets under such a policy.

Looking back at the first three years of operation of the Malua BioBank, it is clear that the project has been particularly affected by the global financial crisis, which would have been difficult to predict at the time it began. Moving forward, the Malua BioBank needs to focus its efforts on creating a market for the biodiversity certificates, because that is the only way to ensure that successes in science and conservation are sustainable. In the shorter term, Malua BioBank is pursuing partnerships with major end users of palm oil who are interested in testing a new approach to environmental sustainability. Food processing and cosmetics companies are prime partners for this strategy. For the longer term, the biobank is working closely with the government of Sabah to develop a regulatory program for biodiversity offsets. Once the regulatory framework is in place, the business model pioneered by the Malua BioBank could be effectively scaled up.

The project revealed two interesting lessons: the importance of predictable demand, and the need for diversity of capital. At the project's onset, the voluntary markets seemed the best way to incorporate biodiversity considerations into the palm oil supply chain. Voluntary markets are usually quicker to develop and to adapt than regulatory markets. However, it is now clear that the demand generated by voluntary markets is less predictable than the demand created through regulation and enforcement, and therefore carries a greater risk.

Developing a biodiversity market requires a diversity of capital sources that may be different at each stage of the project. In the case of Malua BioBank, the early investment of capital to fund the research, capacity-building, and market infrastructure needed to initiate the market required patience. Most of the outcomes of these activities are common goods that will be used by all market participants and not exclusively by the original investor, and private investors are therefore reluctant to fund them. Also, other stakeholders may have concerns about the potential conflict of interest if private capital is used to finance the design of regulations and the scientific evaluation of environmental markets that the private interests will also invest in. Grants from government, international organizations, or foundations could be an effective and transparent capital source for funding these activities.

Once the regulations are in place and enforced and a demand is clearly identified, larger amounts of private capital can be channeled to projects to grow the market and achieve both financial and environmental outcomes. Private capital successes in models such as these tend to be iterative as retained capital becomes available for reinvesting in similar conservation ventures. The interdependent combination of nonprofit start-up capital and private take-out funding greatly enlarges the overall investment pool for conservation, with rewards for all parties involved.

References

Aglionby, J. 2008 October 31. Credit turmoil takes toll on palm oil trade. *Financial Times*.

Brunei Forestry Department. 2003. *The heart of Borneo.* http://www.forestry.gov.bn/heart.htm.

Malua Wildlife Habitat Conservation Bank. 2010. *About the Malua Biobank.* http://www.maluabiobank.com.

Roundtable on Sustainable Palm Oil. 2009a. http://www.rspo.org/.

Roundtable on Sustainable Palm Oil. 2009b. *Biodiversity conservation.* http://www.rspo.org/.

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THE SURUÍ CARBON PROJECT CASE STUDY

by Ricardo Bayon, EKO Asset Management Partners

Overview

The Suruí Carbon Project is a carbon financing scheme to protect Terra Indígena Sete de Setembro, located on the border of the Brazilian states of Rondônia and Mato Grosso. This area belongs to the Suruí, an indigenous tribe composed of nearly 1,300 people, who have committed to reversing environmental degradation caused by harmful deforestation. In an effort to preserve their culture and ecology and improve their economic prosperity, the Suruí have committed to transitioning to more sustainable land-use practices.

With the help of Forest Trends, the Amazon Conservation Team (ACT), Ethno-environmental Defense (Kanindé), the Institute for the Conservation and Sustainable Development of Amazonas (IDESAM), and Fundo Brasileiro para a Biodiversidade (FUNBIO), the Suruí people, through their representative organization, Associação Metareilá do Povo Indígena Suruí, created the Suruí Carbon Project to complement financing of their management plan for Terra Indígena Sete de Setembro. This summary offers a high-level overview of the Suruí Carbon Project from the perspective of Eko Asset Management Partners (Eko Asset), an investment firm interested in supporting the project.

The management plan for Terra Indígena Sete de Setembro is an all-inclusive 50-year strategic plan to direct the Suruí toward more sustainable land-use practices that promote and sustain community and environment health. The plan outlines pathways to ensure economic prosperity and food security, increase capacity-building, promote sustainable land-use practices, and so forth. The Suruí Carbon Project began in 2009, shortly after the Suruí imposed a moratorium against logging on Terra Indígena Sete de Setembro. This moratorium demonstrated the community's commitment to environmental protection and provided the necessary support to move forward with the project.

The Suruí Carbon Project offers financial support based on the voluntary exchange of carbon credits that are generated by Reducing Emissions from Deforestation and Forest Degradation (REDD+). FUNBIO manages the Suruí Fund, which will collect money from the carbon project and help with the long-term financing of the management plan to support education and other community activities for the Suruí people. The Suruí Carbon Project is designed to:

- Protect 240,000 hectares of land
- Provide around 370,000 tons of carbon offsets by 2012 and 1.1 million tons by 2020

Figure 12: Map of Project Area. *Source: Metareila Association of the Surui People.*

The future of Suruí Carbon may have significant implications for the future of REDD+ programs and other indigenous carbon financing schemes. This is the first REDD+ project of this scale, and its successes and failures will blaze a trail for similar projects, particularly those that involve indigenous peoples.

Discussion of Outcomes

Since the logging moratorium was first enacted in 2009, the Suruí have successfully secured investment to finance the project. While financial returns have yet to be realized, there have been significant social and environmental returns; the Suruí organizational capacity has increased, as have direct benefits to the community benefits, such as health and education. The Suruí have also received commendations from international and national agencies in recognition of their alternative forest management practices.

Due to the lack of market opportunities to facilitate the sale of REDD+ carbon credits beyond the scale of the voluntary market, financial returns have not met original expectations. Eko Asset, in an attempt to sustain the project, is interested in investing in Suruí Carbon. Eko Asset would offer capital to encourage the community to continue to participate in the Suruí Carbon Project, continue the moratorium, and follow Terra Indígena Sete de Setembro's management plan. The delay in receiving financial returns from REDD+ credits is causing some Suruí to question the original motivation and potential success of their moratorium, as well as the community's decision to pursue carbon financing. Eko Asset is confident that markets will allow the trade of REDD+ carbon credits, and thus is willing to front the capital

and assume the risk now, while there is a standstill elsewhere in the market. Once the markets allow for the trade of REDD+ carbon credits, Eko Asset plans to sell to prospective buyers.

SUCCESSES

Despite a lag in financial payment to the Suruí community, this project has already produced significant results that will prove beneficial to future carbon projects. They are:

- The 2009 logging moratorium
- Legal due diligence defining indigenous property rights over carbon credits
- A comprehensive informed consent process
- One of the most advanced project design documents (PDD) available to date for forest carbon projects

The community's decision to impose a moratorium on logging in 2009 represents not only a victory for conservation, but also for indigenous people's rights. Baker and McKenzie, one of the world's largest and most respected law firms, was part of this process and put out a legal opinion arguing that the Brazilian constitution does indeed give indigenous people the legal right to sell and benefit from carbon credits generated from their land (Forest Trends 2009). This analysis will have many implications for indigenous people throughout Brazil. Forest Trends, with the help of the project's partners, conducted an extensive education and prior informed consent process to establish the Suruí Carbon Project, including the associated Suruí Fund; the process will be a model for future indigenous financing projects. The success of this project will likely be groundbreaking for other environmental financing schemes in Brazil, particularly those that involve indigenous populations.

Figure 13: Members of the Suruí Community. *Sources: Beto Borges (left); Metareila Association of the Surui* People (right).

Enabling Conditions

Developing this project was time-consuming and costly. Because it is a pioneering project, the upfront investments needed were large. A large component of developing a carbon credit program involves assessing the drivers and outcomes of deforestation, and the support of the Amazon Conservation Team was instrumental in fostering the gathering of technical information related to deforestation. This information was vital in order to structure the Suruí Carbon Project. Most of the work conducted to create this scheme is translatable to other projects, which will reduce the costs and time constraints of future projects.

This project benefited from the release of the Voluntary Carbon Standard (VCS) methodologies for REDD+ projects earlier this year; the methodologies were catalytic for many REDD+ projects around the world. Of utmost importance is the political will and commitment demonstrated by the Suruí community. The community's commitment to sustainable forest management is the foundation of this project.

Moving Forward

The Suruí Carbon Project is currently undergoing validation under the VCS and Climate, Community, and Biodiversity (CCB) standard; validation will solidify the credits' trading potential and hopefully generate additional revenue for the project. Until more markets begin to trade REDD+ forestry carbon the project will not meet its full potential, because voluntary carbon trading does not have the volume to support a long-term financing scheme. The community expected to see a return sooner than it has and is eager to see a payout. Eko Asset has an opportunity to offer initial purchase capital to sustain the project through credit validation and the early implementation phases. If Eko Asset were to invest, it would reassure the Suruí community that the project has a future with carbon markets.

The government of Brazil has been rather neutral concerning this project; it has neither supported nor hampered the effort. No new laws or policies have been created, but it is expected that the government will voice its position and Baker and McKenzie's analysis will influence future policies. Fundação Nacional do Indio (FUNAI), the Brazilian government agency in charge of handling indigenous issues, has closely monitored the actions and progress of this project. There is potential for FUNAI to adopt the methodologies and processes involved in the Suruí Carbon Project as a model for future carbon projects in Brazil involving indigenous communities. With the support of FUNAI and other branches of Brazilian government, the likelihood that additional markets will trade REDD+ carbon credits will greatly increase and bring this project closer to realizing its full potential.

References

Forest Trends. 2009. *Baker & McKenzie legal analysis: Surui REDD project.* http://forest-trends.org/publication_details.php?publicationID=2600.

Recommended Citation:

Bayon, R. "The Suruí Carbon Project Case Study." In Measuring Nature's Balance Sheet of 2011 Ecosystem Services Seminar Series. Edited by Coastal Quest and Gordon and Betty Moore Foundation, 371-373. Palo Alto: Gordon and Betty Moore Foundation, 2012. PDF e-book.

CONCLUSION

Innovation in an arena as new and complex as market-based ecosystem services programs is inherently challenging. Yet the practical application of ecosystem services theory provides an opportunity to align economics with ecology that has been long sought after in the conservation community. The case studies presented here demonstrate practices that are being applied to mitigate environmental threats in both developing and developed economies, and begin to articulate the potential scale at which these practices can be applied.

While these case studies highlight a number of governance, institutional, and equity issues for which there are still, perhaps, more questions than answers, they demonstrate the range of resources and creativity that are being harnessed. As we continue to face significant environmental threats resulting from economic incentives to harvest and mine natural resources and to otherwise develop land, structural solutions that recognize the financial value of the productivity of intact landscapes — known as ecosystem services — have never been more needed.

Recommended Citation:

Davis, A. Introduction & Conclusion. "Ecosystem Services in Practice: From Theory to Application." In Measuring Nature's Balance Sheet of 2011 Ecosystem Services Seminar Series. Edited by Coastal Quest and Gordon and Betty Moore Foundation, 359-361,374. Palo Alto: Gordon and Betty Moore Foundation, 2012. PDF e-book.

Seminar

5

Ecosystem Services in Practice: Market-Based Ecosystem Services - From Theory to Application

Speaker

Adam Davis · Dave Batker · Dr. Ben Guillon · Ricardo Bayon

2011 ECOSYSTEM SERVICES SEMINAR SERIES

GORDON AND BETTY MOORE FOUNDATION

Ecosystem Services Seminar 5: Ecosystem Services in Practice: Market-Based Ecosystem Services- From Theory to Application

Presentation and Discussion Notes From Panelists: Mr. Adam Davis, Mr. David Batker, Mr. Ricardo Bayon, and Dr. Ben Guillon

Seminar Series and Seminar 5 Goals:

The goal of the multi-session seminar is to educate the broader conservation community including practitioners and funders on the diverse aspects of ecosystem services – such as how to account for ecosystem services and to effectively measure, manage, and communicate them.

Seminar 5 and associated readings focused on the following goals:

- *Status, and current trends in market-based approaches, including payment for ecosystem services*
- *Strengths and weaknesses of market-based approached, including risks and benefits associated with specific market approaches*
- *Scale of market-based ecosystem services implementation*

Disclaimer:

This document is a summary that includes PowerPoint slides from the panelists, Mr. Adam Davis, Mr. David Batker, Mr. Ricardo Bayon, and Dr. Ben Guillon, and notes of their talking points. In addition, we provide a synthesis of important questions discussed during Seminar 5. Please keep in the mind that the following document is only a recap of the presentations and Blue Earth Consultants' notetakers have, to the best of their ability, captured the presentations. We hope that the following presentations and discussion notes will be used as resource to advance further discussions about ecosystem services.

GORDON AND BETTY MOORE FOUNDATION
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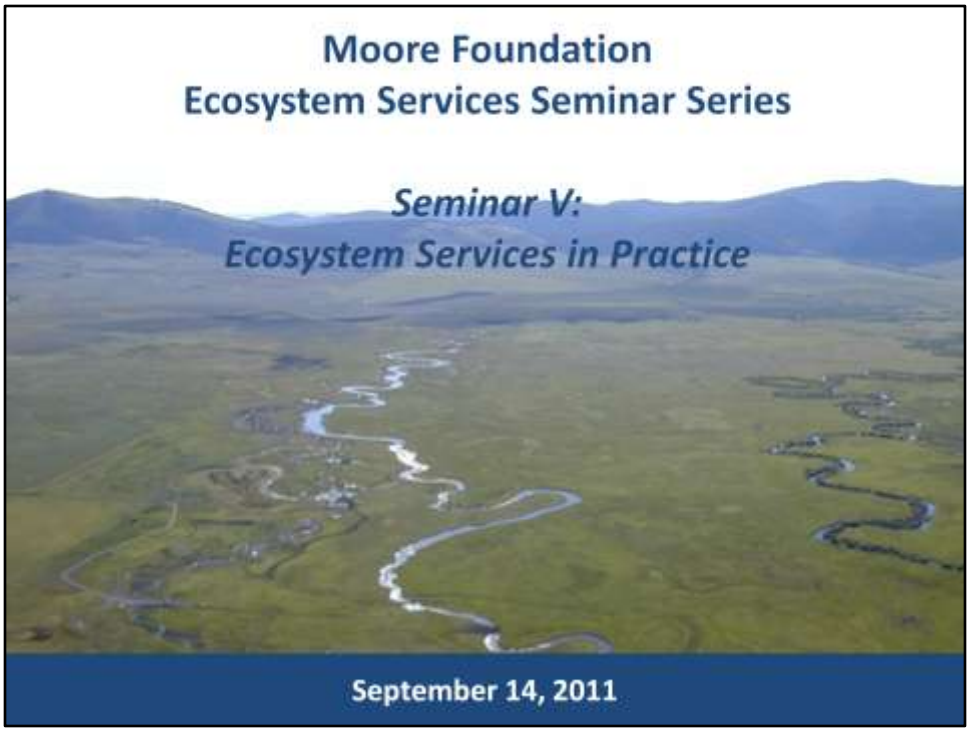


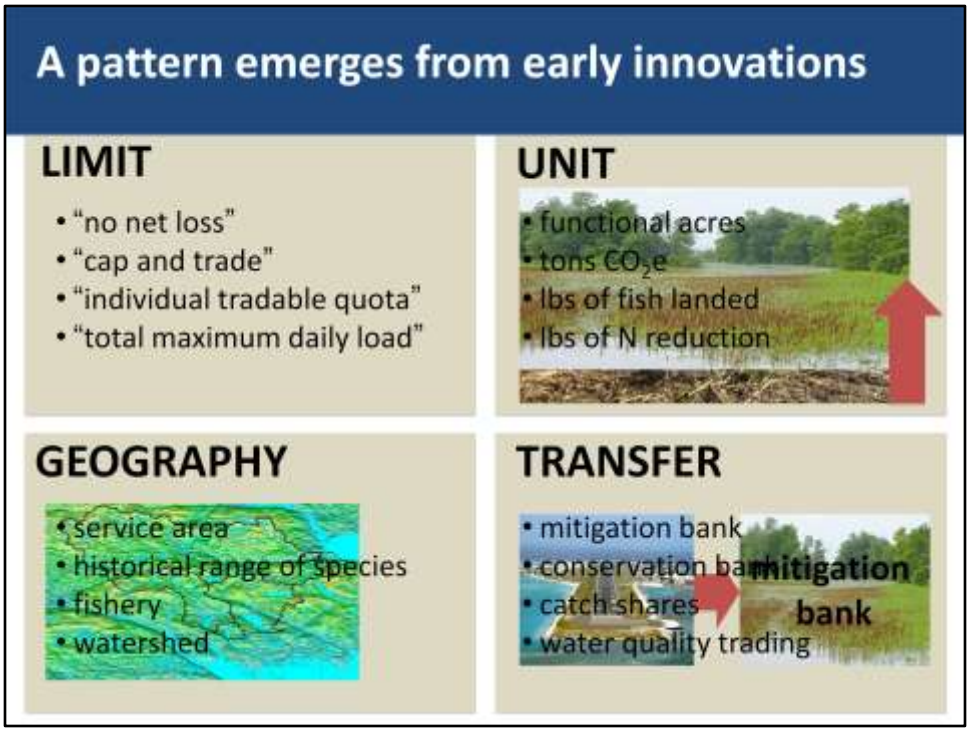
Mr. Adam Davis

- In reviewing the previous seminars, I was captivated by the way the series has captured the progress of the ecosystem services (ES) field and how it has mirrored it perfectly by starting with theory and moving towards the application of concepts. It reminds me vividly of my personal trajectory.
- I remember the first major conference after Gretchen Daily's book, *Nature's Services: Societal Dependence on Natural Ecosystems*, which was a bold book for an academic that discussed the need to address economics beyond science.
- There is a great deal of discussion grappling with the financial value of nature. Are these things real? Are they measureable? How do you do it? Etc.
- Since the Katoomba Group meeting of international thought leaders in early 2000, the field has progressed rapidly.
- At EcosystemMartkeplace.com, our contribution really was to take the complexities of ES and to begin to categorize them into water, carbon, and biodiversity markets. My next step was working at an electric power research institute on their ecological asset management program. That was the first attempt to try to assess pure economic value for companies.
- Since then, I have entered the applied side working with large companies like DuPont, and addressing natural resource damages at Seattle superfund sites. Environmental engineering firms, and the federal government are very involved in these sorts of issues. I have spent time working on inter-agency dialogue to make federal environmental program spending more accurate, targeted, and to make regulation more efficient and effective.

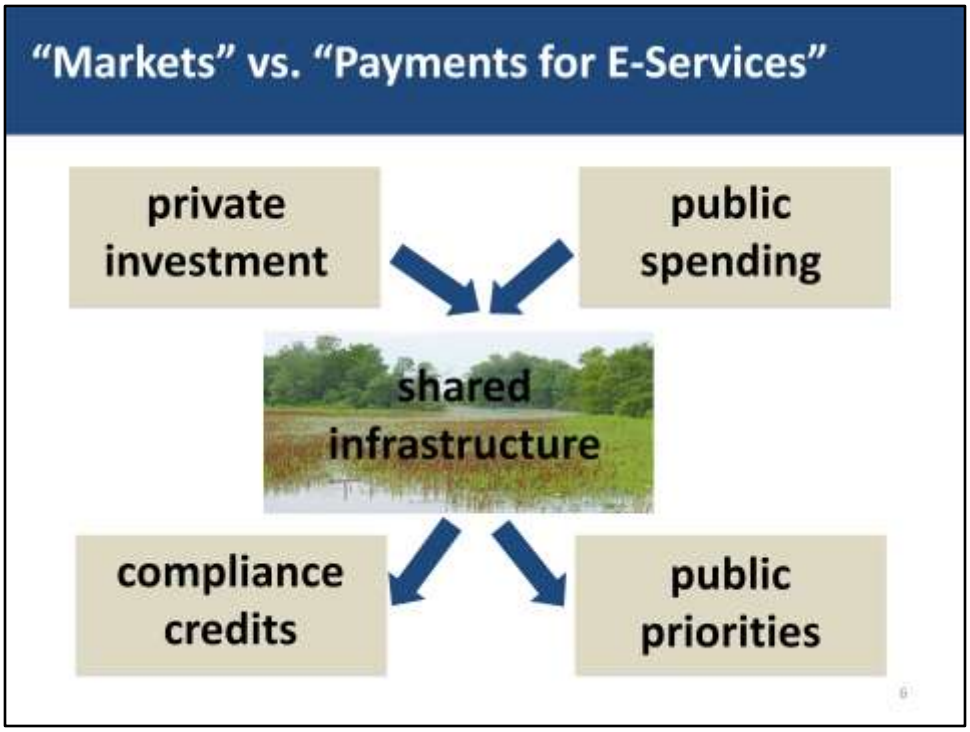
- I am very pleased to moderate this panel. We have excellent case studies that will bring the concepts down to earth in a concrete way.
- I will make two points before we turn to case studies. One is about the breadth of problems to which this idea is being applied. The second is more about the terminology we use in ES. The jargon is confusing and is often a distraction from a simple value.

- We have applied environmental law to many places over the years. In every case, the fundamental environmental laws have said “stop it” by basically controlling limits.
- At the time, this tactic of “command and control” was absolutely necessary, but we have since hit a limit of imposing limits.
- We have moved beyond fines and fees to a place where we need to find a balance between economic growth and our need to protect the environment. These ideas are not a notion anymore, we have 20 years experience across a broad range of problems. We need to apply real incentives to not only stop what we do not want, but also to encourage what we do want.

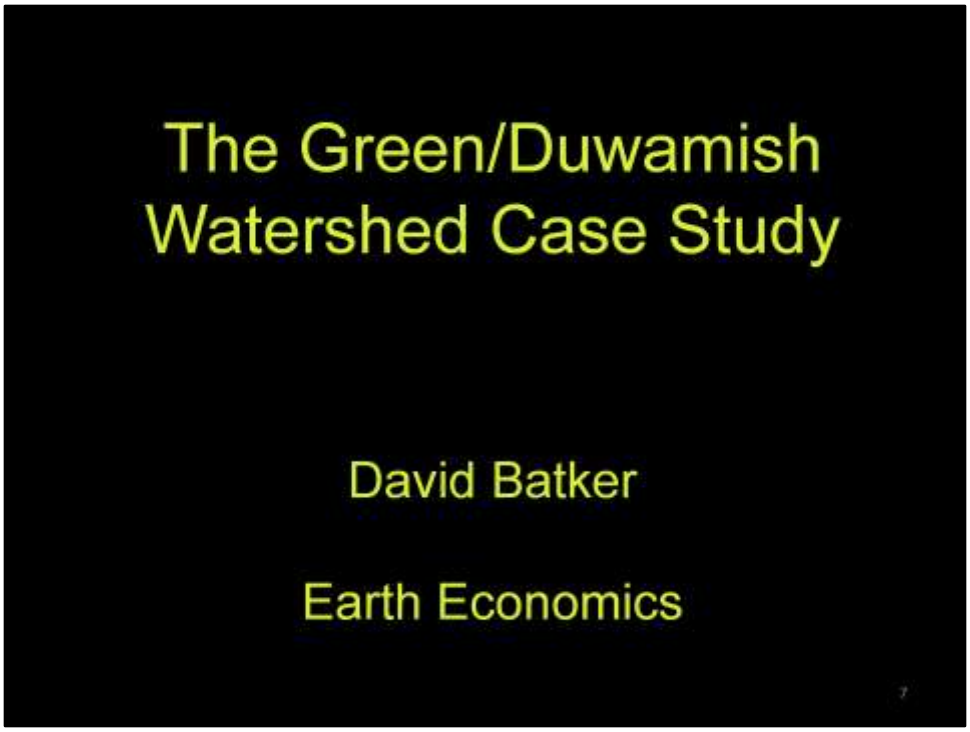
- This slide lists the incentives we have created to encourage investment.
- The fundamental point is that these ideas are not a small boutique notions that are experimental. We have over twenty years of experience with them and they are being applied to a lot of environmental problems.



- On to my second point about jargon - this is my attempt to boil it down.
- In every case there is a "limit" which can be referred to as a "cap," "maximum daily load," etc.
- There is always a unit or measure.
- There is always a specific geography.
- They is always a transfer of legal liability.
- These elements exist in all market mechanisms. They are the basic elements; when you see this pattern, you can recognize it as a market solution. People attempt to call them by different names, which is where we get additional terms and increased confusion.



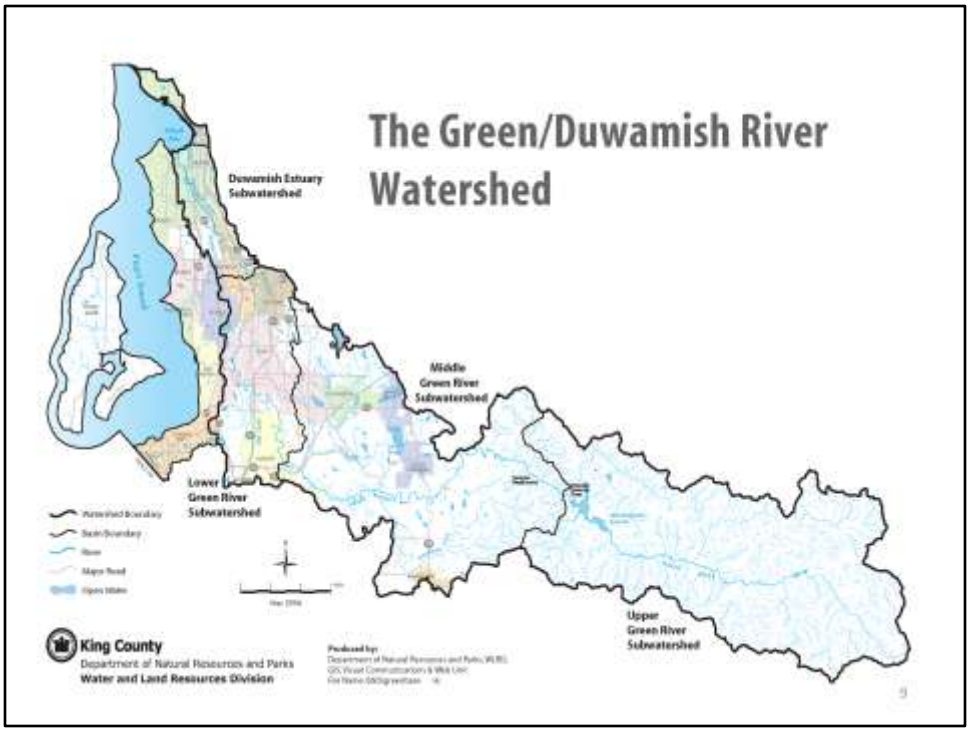
- My last point is that you will hear a lot about market mechanisms in comparison to payment for ecosystem services (PES) programs. The two are very similar but the fundamental difference lies in where the money comes from.
- In private institutions, you have private investments that create scientifically verified ecological uplift that offers a compliance credit.
- Other side, public spending is applied to public priorities.
- ES are adding a unit of measure, essentially creating discipline of what we measure, which did not exist before. Now there is a shared infrastructure of metrics and accountability which is applied in compliance and helps enable offsets and oversees the way we use public funds to support public priorities.
- In both cases, we are using the science of ES to tell us how to evaluate our spending and allows us to be more accountable.



Mr. David Batker

- To add to Adam's point, a lot of times we look at the scope and scale of a project, which may not be sufficient to accomplish your goals. Usually, it takes more than one market to accomplish your goals.

- This is a map of the Green River watershed in Washington state. As a quick overview:
  - It has the most industry in the state ($100 billion); it is where Boeing is based.
  - 600,000 people live in the region
  - There are 16 cities with 16 different storm water districts
  - There are multiple flood districts that have since merged into one
  - It is an important area for Chinook Salmon
  - There is a lot of privately owned timber land
  - Most of the Farmland is in King County
  - It gets very urban and industrialized out by Seattle
- Some of the problems facing the region include:
  - Flooding, storm water, wetland, transfer of development rights, and each have their own unique mitigation methods



- In this first case, we focused on salmon. We realized that you could not effectively conduct stream restoration for these salmon unless you invested $300 million, which is well over what we could get from typical sources. We started looking at markets and PES and brought 16 cities together over five years.
- We did valuation of ES in the watershed and showed there was somewhere between $40 billion and $200 billion in value provided by the surrounding forest. For this valuation, we used a simple benefit transfer approach, which put a wide mark and showed that yes there is a lot of value!
- Then we explored 25 different funding mechanisms, one of which being wetland mitigation banking.
- In working with 16 cities, we realized that there is no one jurisdiction that can actually implement the restoration and coordination necessary for this type of initiative.
- There are over 150 tax districts in this watershed. We were able to get them all together by merging some tax districts and setting up infrastructure to improve salmon populations while increasing property values and water quality.
- Finally, we realized we needed one last tax district. A lot of cities knew they could not handle storm water, etc. If you are a flood district, you cannot pay for the margin to recharge ground water. So, we considered taking a system approach and the group voted unanimously that this type of approach was the best. We do also have a trading approach that is being used in many places like Eugene. Eugene is another example of where we are also working.
- This is all about physical problems: physical stops and flows that need to be changed. Our society has a set of solutions, but the way we allocate is based on financial flows, stocks, and expectations. Whether investment comes from investments firms or from government, they all have different mechanisms and expectations.

- Next, I will jump to discuss some national work with Seattle, Tacoma, San Francisco and New York and smaller utilities. The seller is not the problem; plenty of people want to do this. It is the buyers who have the issue.

    - Why is this the case?

- Our accounting structure does not support the right incentives, they are omitted from your asset sheet.
- The cities I mentioned all have forest-filtered water. Seattle avoids $200 million in filtration costs because they use the forest to do it naturally. On the other hand, they all have to make investments in those watersheds. For instance, Tacoma wants to pay farm owners to change the ways in which they manage their lands to preserve water quality. You cannot take a bond out for water filtration, but if you take out a road to reduce runoff, it is a write down. What bank will give a loan for that? None will; we need to change this kind of accounting. Producing or filtering water saves companies lots of money, but it is not reflected on their balance sheets.
- We need to change accounting rules if we are going to make any headway with this. We want to start with the biggest issue and water is the best. We can bring together the clout to change accounting rules. This will change in the next five years, hopefully, and it will affect all federal agencies, private landowners, timber companies, etc.
- Right now, ES do not count in the Army Corps of Engineers' cost-benefit analysis, but they are considering making changes. This would be a sweeping change that would be absolutely crucial. It would probably mean we could overlap $100 million dollars for the salmon restoration project. It would also mean transactions between all sectors.
- Because it has the aspects of merging tax districts, which Republicans like, and actually doing restoration, which Democrats like, it seems likely to happen.
- You always want to find the case where you can show a trade where someone is going to make money.

    - Where is it going to work well?

- An established market, like electronic-waste is easy to work with. Establishing a new market is really difficult.

- We are working with FEMA who is guaranteed money every year. They have one tool for everything, no matter what the disaster: flood, hurricane, tornado, earthquake, etc. You go online and put in your claim and then they decide what loan you get. Now FEMA wants to incorporate ES into this framework, which is important because people can move out of the floodplain. This will be the first time we offer these sorts of values to change their cost-benefit analysis, and it is a simple appraising and benefit transfer approach that fits well with FEMA's model.
- Now we are thinking about a comprehensive solution to an entire watershed system.

Audience Questions:

Participant

- You talked about bringing all agencies together and that is what seems hard to get. What did you do to get them to agree and come together?

Dave Batker

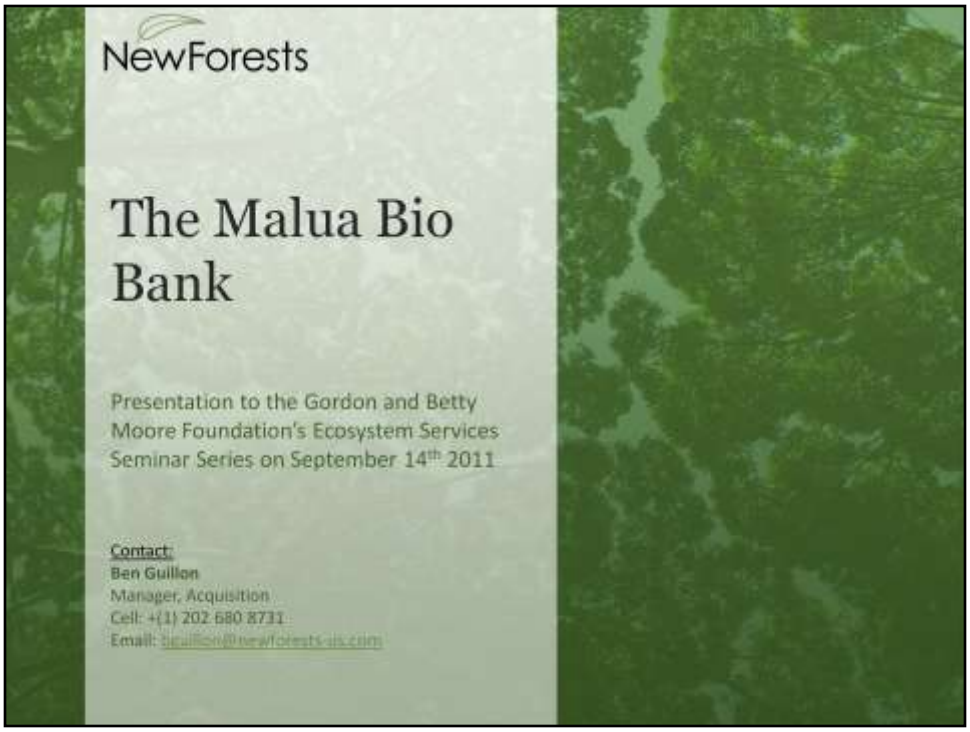
- The Water Resource Inventory Area (WRAI) region 9 (Green River Watershed Region) got all the cities to come together and had a steering committee of 70 people. They were not used to unanimous decisions and a few important things happened to get it. There is nothing like sealing a deal to make things go forward. We did an analysis to calculate flood protection instead of salmon restoration and they loved it and realized that maybe they could look at ES. They voted unanimously and recognized they were on the same page, which helped things move forward.

Participant

- When you mentioned $40-200 billion in value for this particular watershed, did you mean annual or present value?

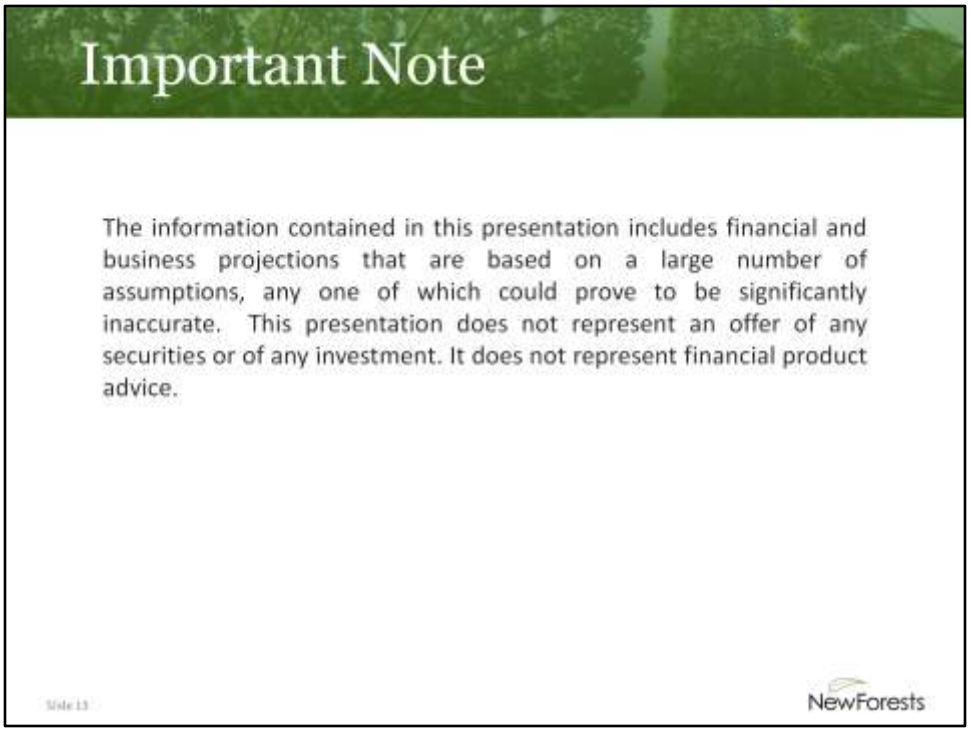
Dave Batker

- We used two values. First, we calculated the ES value and then we annualized it and calculated back to get the asset value. Again, it is an appraisal approach. Natural capital appreciates, and is something the business community can grasp and love, while built capital will degrade and fall apart.

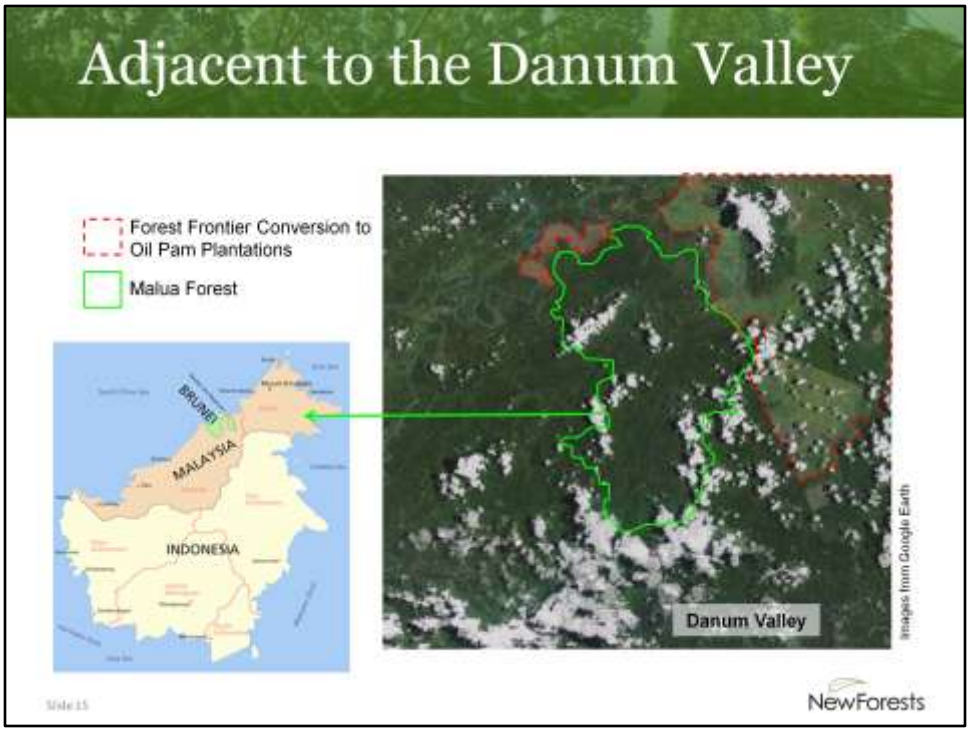


Dr. Ben Guillon

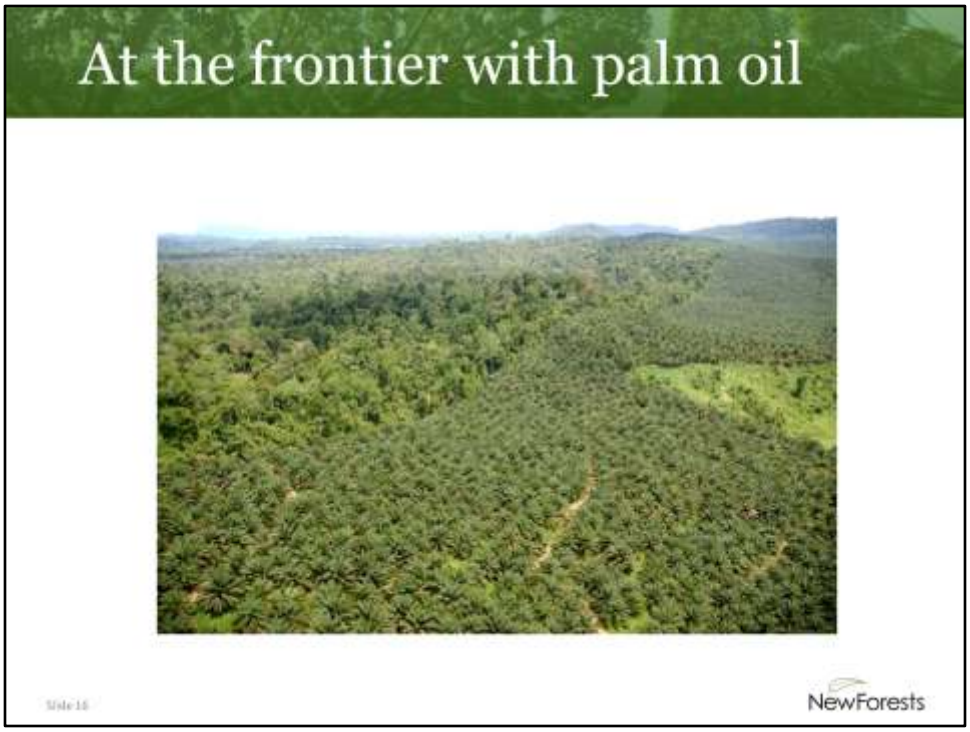
- Before we begin, I would like to give you a bit of context on New Forests. It was funded in 2005 and we now have 30 staff members in three offices: Sydney, Singapore, and San Francisco.
- We are a financial management firm that focuses on ES. We have many investors; our main investor is Generation Investment Management, the company funded by Al Gore.
- New Forests has land totaling the size of Rhode Island, approximately, and over $1 billion in assets and management. We raised $50 million for mitigation banking and forest carbon.
- I started in the field and moved to the World Bank to work on ES. When I saw this project with New Forests, I decided I wanted to try it for real. I manage the funds on the financial side.
- We make judgments based on information we have and then we adapt as information and the world changes.
- We developed this particular project in 2008 and then the world changed. This is really an issue when a project is based on markets.


Important Note
The information contained in this presentation includes financial and business projections that are based on a large number of assumptions, any one of which could prove to be significantly inaccurate. This presentation does not represent an offer of any securities or of any investment. It does not represent financial product advice.
Slide 13
NewForests

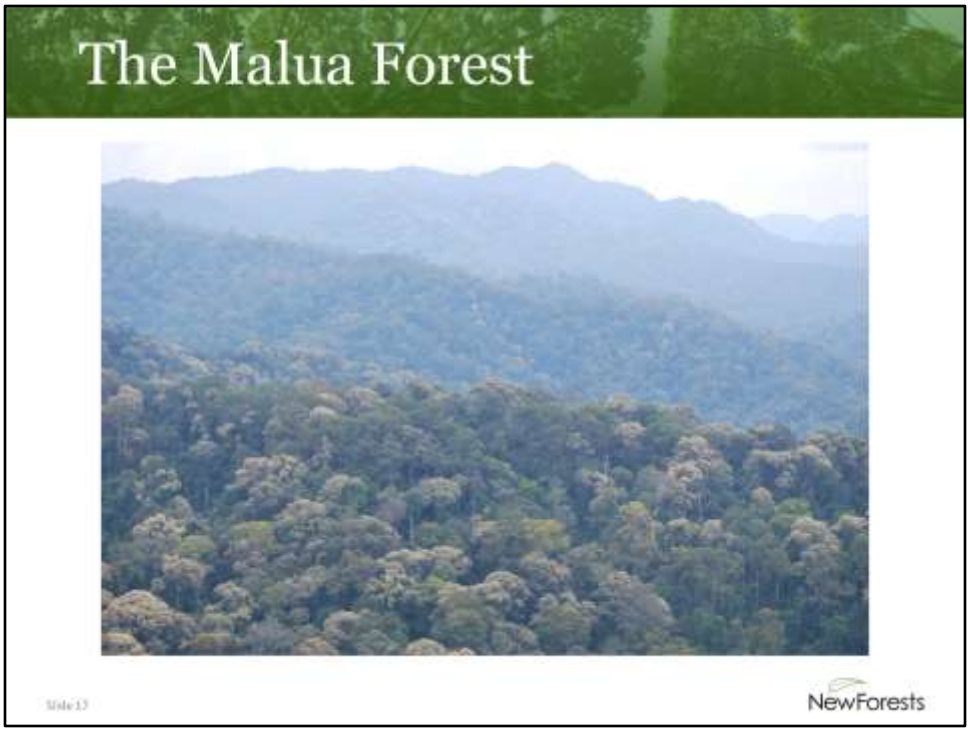
- Originally, this project was based on an alignment of stars. The palm oil industry came together in a roundtable to think about how to green the palm oil supply. On the other side, the government, who had logged most of the forest and realized there was no future, was looking for a paradigm shift to make money on forest without cutting it.
- New Forests worked with Forest Trends and their program for biodiversity offsets. We tried to apply what we learned in the USA to these particular issues. We decided to focus on palm oil.
- The roundtable on sustainable palm oil allows you to be certified but you cannot be on plantations of certain types. New Forests would provide them with the voluntary tool that mimicked USA mitigation banking to provide offsets over two years. The framework we used in this case is very similar to that of wetland mitigation in the USA.
- We picked the Malau Forest Reserve.



- The Malau Forest Reserve is on the eastern side of Saba.
- Green represents the Malua Forest Reserve.
- Red shows where palm oil is located.
- Once the area is logged, the only way to make money is palm oil.



- In this picture, you can really see the border of the reserve and how palm oil plantations are built right up against it. It shows how palm oil is really encroaching on the forest reserve.
- The reserve encompasses 34,000 hectares. We found this size to be manageable while still providing enough space to have an ecological impact.
- There is an abundance of species, many of which are rare, such as rhinos, elephants, gibbons. Many species have been pushed from other places because of human population expansion.
- The government said no logging for 50 years, so we have that much time to produce results. Government is responsible for anti-poaching activities.
- New Forests is providing $10 million for restoration and is responsible for the marketing and selling of credits, either Reducing Emissions from Deforestation and Forest Degradation (REDD) or biodiversity credits. We chose to focus on biodiversity.
- It is a for-profit venture in which 20% of profits will be managed by a third party and reinvested to incentivize government to support the protected area after 50 years. The rest of the profits are split evenly between the government and New Forests.
- In mimicking the mitigation system, we took a bundled approach rather than go into functions and get too complicated. We defined a credit to be a 10 by 10 hectare and whatever services are provided within it. The exact methodology is still in development, but we created an advisory committee with local NGOs, government officials, etc. We selected people who felt they knew and owned the territory in order to solicit buy-in and get everyone comfortable with the idea.



- Now, three years later, it is not what we expected. But we have had great conservation success: we stopped poaching, there is a rhino in the forest who is one of only 40 left.
- It was hard to find an agreement on the conservation objectives. Some wanted a wilderness concept while others just wanted to increase the capacity despite the original density. It took a while to get everyone on the same page.
- Of course the financial market had a significant impact on the project. The price of palm oil crashed 50%. The big companies were working with us because they were only interested in greening to obtain the premium price. After the market crashed, the prumium no longer existed in the same respect.
- The fund was growing at a much lower pace than we wanted so we switched from targeting the supplier to targeting the buyers, i.e., Este Lauder. Greenpeace had independently come down pretty hard on those companies so it was easy to open doors with them.
- We have also worked with social media. In two months, you will see a new website where you can buy the credits online. We are engaging with Zynga to integrate the credits with games like FarmVille. We also created a partnership with a food company to provide a redemption coupon on a food box. Consumers could redeem the code for cash or use it to buy biodiversity credits. More than 20% of people who redeemed the code from the box chose to buy the credit over receiving money back, which was an interesting success.
- When you have a voluntary market and want to switch to a compliance market, it takes lots of time and we are still working on it.

- I would like to repeat three points to conclude:
    1. We have learned a lot from this project. Using the mitigation experiences from the USA was a great thing. It helped us establish a track record and helped us gain confidence and trust with the Malaysian government. We have learned how it is important to start simple, which may not be the best solution from an ecological perspective, but the bundled approach is must easier to communicate and manage. Transparency was also really important . Even if the science was not really sound, we were very clear and open; we put everything on the website so all partners were able to access everything.
    2. It is important to determine who is going to buy credits. What are the drivers? You need to have methodologies in place and agreed-upon goals, criteria, and indicators before you start. This will help when you get going and discuss indicators. This example really had a spectrum of voluntary and compliance based mechanisms for a lot of transnational industries. Self-regulation can be an option, but it is not the best. When industry can see the benefit, they can set the standards really quickly. The roundtable is effective if all partners are engaged.
    3. Picking the right financing is crucial and I am not sure we have found it yet. We did not use the full spectrum. Our investors in the company and the institutions that gave us money are not patient and expect returns quickly. It is hard to create a new market with private equity capital; it is not the best use.

- From now on, we will work in three steps:
    1. Might be wise to first start with a grant to get a roundtable going and make sure participants are willing before moving to develop methodologies. Grants are important here because we need to assess all important players. Indigenous people may not be the focus of private investors like they would be for NGOs or foundations.
    2. Next step is to start a pilot project. The risk is such that there is a need for incentives. Maybe guarantees, etc., these are ways to promote early development of pilots.
    3. Once you have showed that the pilot works then you can raise private equity capital. Once the concept is proven, getting capital is not really an issue.

Audience Questions:

Participant

- Your revenue stream is several types of credits correct?

Ben Guillon

- Exactly, now we have moved to focus on biodiversity but with the idea to develop REDD in the future. The issue working in Malaysia is that they have delegated management of forests to the states. It is complicated and you need the national and state levels to talk.

Participant

- It is tough to compete with palm oil? Have you compared how your revenue streams compare to that of palm oil plantations?

Ben Guillon

- Currently the only people who have logged credits are global business men. We are still in the concept stage and are trying to change the way we approach the market. Palm oil is so productive that even if you attach a small premium it will present a lot of money. You can really translate that and we think it is highly competitive.

Participant

- What are the substitutes for palm oil?

Ben Guillon

- We are not trying to substitute palm oil. We are trying to increase green palm oil. If you look at productivity, palm oil is way more productive than its alternatives, which would need more land if you were to stop palm oil. Good palm oil is not that bad. Biodiversity on the plantation is zero; it is not perfect, but it is what you need.

Participant

- This is a mitigation plan? Are palm oil producers required to pay into the bank?

Ben Guillon

- Originally, yes if they wanted to be certified. The thing is that the methodology is not that well defined. We do not want people far away to buy credits. This is why Forest Trends would work. We are competing for the use of land with palm oil. Palm oil or something else which could be sustainable forest management. All the very valuable trees have been removed. There is no low-impact logging, which is why biodiversity credits were appealing.

Mr. Ricardo Bayon

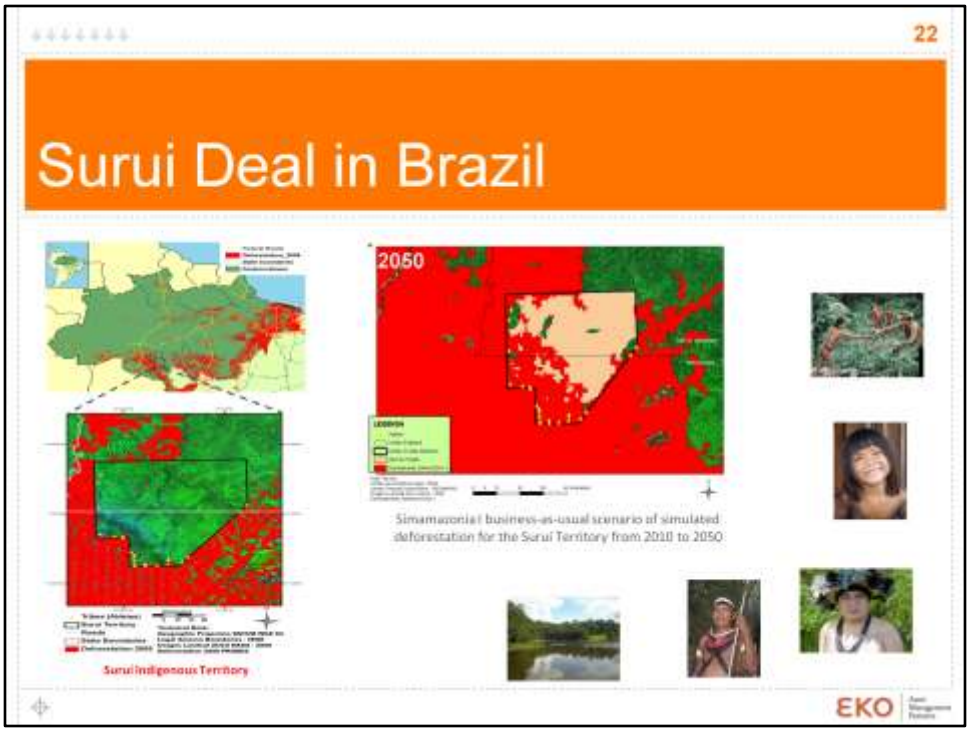
- This is a fascinating picture of the earth that I want to share with all of you. The white lines are air routes, the blue lines are boat routes, and the green lines are roads. Together, it looks like we have covered the planet with a network of spider webs. What captivates me in this picture are the dark spots.

    - Why do the dark spots not have value? What kind of value do they have?
    - How do you attach value to them? Do you send out an economist to do it?

- Think about coffee, you do not ask an economist to assess the value of your morning cup? There is an appraisal stage, but the market sets the actual price.
- We have sent economists to the dark spots and they tell us how much it is worth, which helps to get people moving and thinking.

    - But how do we get the numbers to make markets and really get values?

- I do think markets will be a way we do that. Government will have to set limits on a public goods and start trading.
- Scarcity is also really important; it is what drives value. Even in a private market where a company sells to another somewhere else. Scarcity value is created by the government setting those limits.
- The problem is that we are running on outdated software in our economic system. It was created at a time when capital and labor was scarce not natural resources. At the time, we wanted to get rid of our resources; the system was created for a market about labor. We live in a different world where the demand for ES is increasing and we no longer have an abundance of resources. There needs to be a flip. This is why we created out investment firm in 2008; because we knew that his flip was coming.

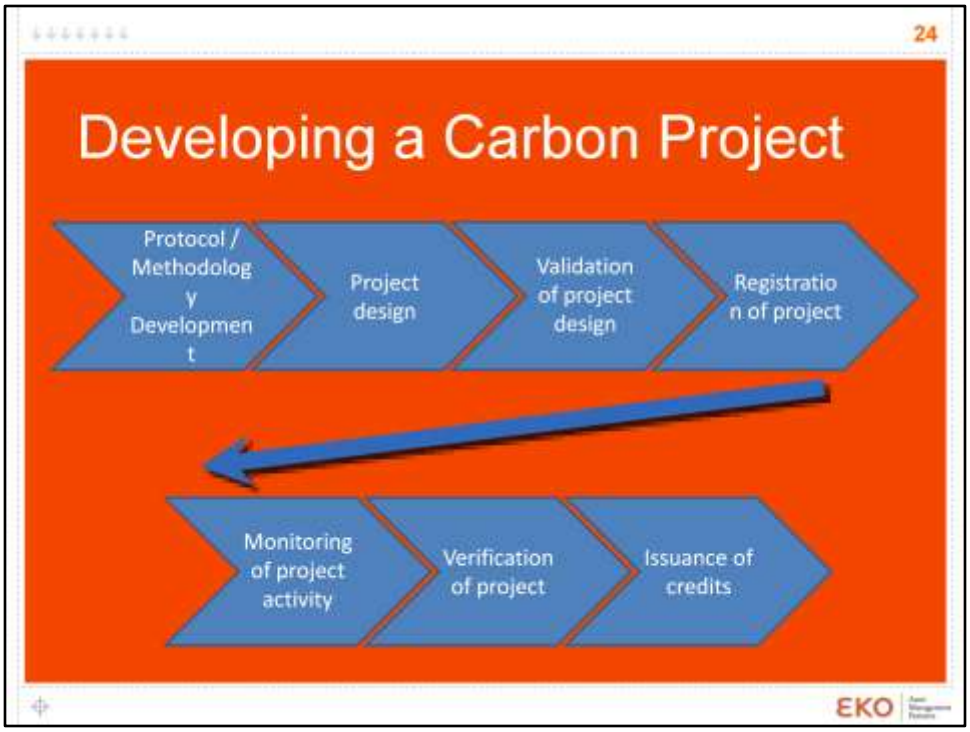


- This project takes place in Rondônia, Brazil. In the images above, the area in red represents deforested from soybean agriculture while the green shows the indigenous territory. The Surui people have about 240,000 hectares involved in this transaction.
- The community of more than 1,000 people decided that they wanted to take advantage of carbon markets to protect the forest and offer survival alternatives.
- Along with Forest Trends, I have been working on ways they can enter into carbon markets.

    - Where is the demand?

- Right now, there is a huge carbon market in Europe but it does not allow forest carbon. Most of the $100 billion that is traded are allowances. Clean Development Mechanism (CDM) has not allowed REDD, but they started talking about it five or six years ago, so maybe it will happen in a few years.
- Voluntary carbon markets are hard to categorize and is not huge. Nearly $400 million/year is traded in voluntary carbon transactions, the majority of which come from REDD. Largely because we have methodologies for it, we believe that Europe will let it in at some point.
- Also, California (with AB32) has talked about letting REDD into their markets. Eventually it will happen, but is unlikely to occur before 2015.
- Surui are using voluntary markets. We are using the REDD framework to establish their own measurements through the voluntary carbon standard (VCS). It is new since it was applied in July.
- VCS looks at what is on the land at present time to get a baseline. Then they model what will happen if you do not continue with a project, i.e., how will it change a landscape and

- affect carbon emissions, etc. They also look at what will happen if the project continues, if you protect the land – many variations. Then you compare the scenarios. The carbon credits are the difference between what would happen and what will.
- What would happen involves some very complex equations. You get into issues with additionality, etc. And it is complicated to get this info; it requires a PhD to go through formulas. Once you register the credit, you can sell it. Then it is verified and monitored by the third party to makes sure what you said will happen actually happens.



- The diagram above is a representation of the process behind creating a plan of this type. It takes a lot of time and money ($100's of thousands). The project design stage often costs $30,000-50,000. The verifying stage will run about $30,000-100,000.
- We have been working with the people of Surui for three years and the communities are wondering if it is real and if they will ever see a profit. You can sell a project before it is registered, but you will sell it for less. It is governed by risk and reward.
- There are two fundamental human characteristics that drive business: greed and fear, which we call risk and reward. This is true for environmental markets as well. In the carbon market, the bigger the risk, the greater reward we expect at the end of the day.
- We are trying to come in with capital now, before registration and make this project more viable and keep the communities engaged. But then who will buy? We have investors on the voluntary side. We anticipate that Europe will put this on the market so we will buy now, but at a lower price.
- Until there is a real market for forest carbon, all we have is the voluntary market. The voluntary market is something, but it is not big enough.
- At EkoAsset, we get five or six REDD projects every week. Of them, we can discount 2/3 because they are poorly done. Of the remaining, some are too big; they involve millions of hectares. The big questions is whether there will be a supply and demand mismatch at some point. We think yes, there will be.
- Eventually, if the timing is wrong, it will be tricky to execute a project like this. We are looking at this project, because we know where the buyers are. Other thing, is the money available to support this project has allowed it to come to this stage.

Audience Questions:

Participant

- Are the methodologies you use repeatable?

Ricardo Bayon

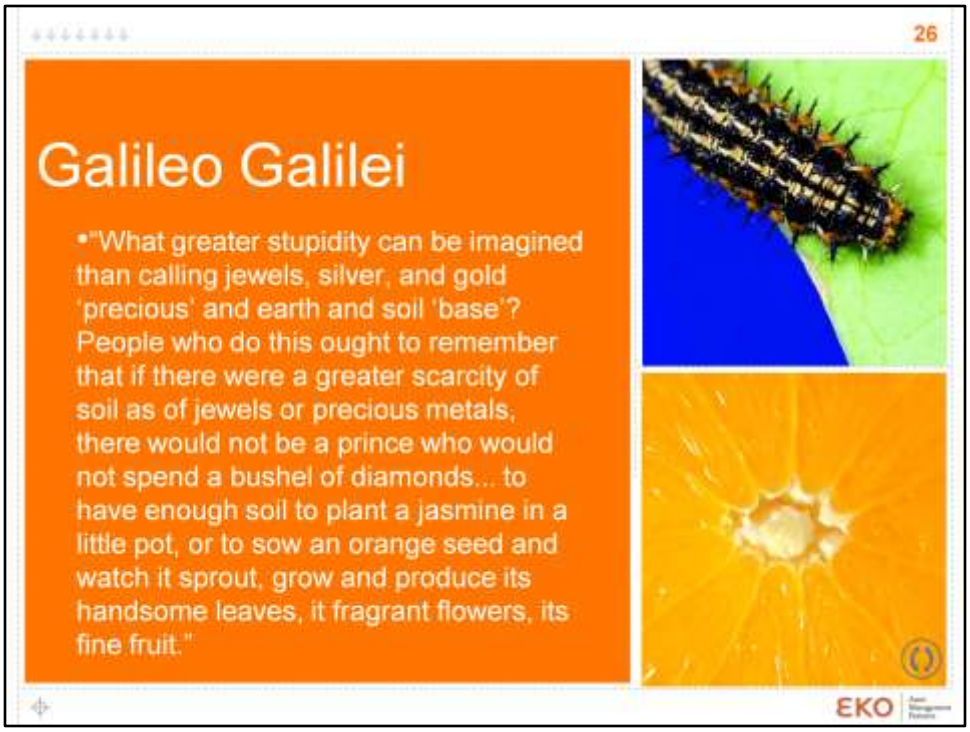
- They are repeatable, and you can take them from other projects, but if you need to create your own, it is costly. Now the laws are such that one can get royalty payments from their methodologies. People were being too specific so a royalty system was set up to allow more sharing.

Participant

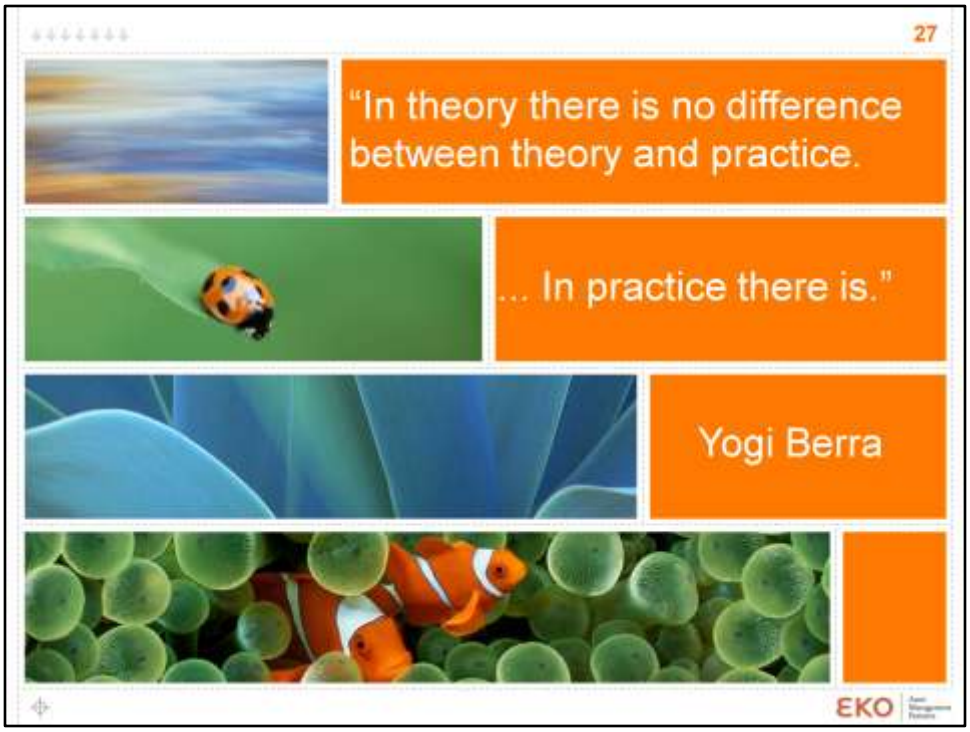
- My sense is that the demand is decreasing as the political climate is more uncertain, is that true?

Ricardo Bayon

- Not sure I would totally characterize it that way. People are raising significant funds for REDD because people think Europe will allow forest carbon. Also question of California and what they will do.
- Next week there is a big meeting in Borneo that will look at all of this.



- The paradox of scarcity is not new!



- To conclude, know that it is hard to get these sorts of things going.

Audience Questions:

Participant

- Have you been in tune with what is going with the price of carbon in Australia and the way if affect credits?

Ricardo Bayon

- Australia has gone back and forth many times and now it is settling down. I do not think that it is affecting credits.
- What people are watching is the development in Brazil and China to create internal markets. Brazil, China, India, and Japan may all have carbon markets before the United States does. All together, it could aggregate up in terms of demand.

Participant

- There is an evolving domestic market in Brazil where REDD credits are the cheapest.

Ricardo Bayon

- Nested REDD is a big issue I did not address. You cannot look at the project level because deforestation can just move to a diff area. You need to look at a bigger scale, at the state, province, region, etc. From a private perspective this is a very risky affair. That kind of risk is a bridge too far and how we deal with it will be huge.

Participant 9/14/2011

- If the Wal-Marts of the world, regulatory regulation aside, are all interested in more sustainable practices and define more sustainable sources of soy or palm oil by including carbon credits, how credible do you think that could be?

Ricardo Bayon

- I think that is a credible way to do things. Integrating carbon into the supply chain is another way this can be incorporated and demand can increase. It could be very powerful.

Seminar 5 Discussion Synthesis

September 14, 2011

This document is a synthesis of important topics and questions discussed during the question and answer and discussion period immediately following the panelists' presentations. Please keep in the mind that the following is only a recap and speaker identities have been removed, except for those of the panelists. We hope that the following notes and discussion questions will be used as resource to advance further discussions about ecosystem services.

Below you will find a summary to specific key questions and topics covered during the seminar discussion.

Question 1

To follow up on the idea of leakage and determining the balance for market activity and permits, what is the appropriate balance between scientific rigor and market activity?

MR. BATKER

- On one hand, we have physical stops and flows and on the other, we have financial stops and flows. We now have a plethora of methodologies and ways to measure ecosystem services, which is good. We are getting a better handle on the physical changes. On the other hand, we have nothing to bolt on that connects the physical changes to the financial world.
- We have developed a database for ecosystem services calculations. We should at least look at it to get an idea on how to form a market on the financial side. For instance, Eugene Water and Electric will take values, look at a range, and figure out where to spilt consumer surplus.
- We need to look at the way we make decisions in standard markets, that will lead us forward. In standard markets, we use appraisals. There are many criticisms for using appraisals but they are a quick benefit transfer. We need a way to get marginal physical changes to have value financially; we need connection. We need this at scale; a web-based tool that can allow for some set of values that can be plugged into a financial framework.

Question 2

What is the most likely way to get the connection to financial value to happen at a large scale?

MR. BATKER

- We want a web-based tool that investors can use. They can look at it, take the information, and incorporate into their pro forma.

MR. BAYON

- I sometimes worry about having too much valuation because if you do not have someone willing to pay, the valuation does not mean much. The real value is if someone, Federal Emergency Management Agency (FEMA) etc., can commit to whatever amount. That is really where a market, as oppose to a valuation study, is stronger. There is a saying, "if you line all economists end to end, they would not reach a conclusion." There is a lot of debate and theory, but unless it actually happens, what is it worth?
- Going back to Adam's question – this is a critical point. It is hard to know when there is enough science. You can know when there is too much, which shocks scientists who want 99.99999% certainty. The issue is that when you wait to get that level of certainty, we miss the opportunities. You can also know when you have too little science. People want certainty and updated numbers but there is a balance; it is a kind of Goldilocks zone.

MR. BATKER

- Wal-Mart is accustomed to driving prices down. When you can show the value gained at each step in the chain for a product, then you can say that someone will pay more because it can increase the profit on product X. You have to lay out a path within the product for the purchaser to show greater profit.

DR. GUILLON

- People always see profit as bad. Either you are able to explain why it is not bad and explain why it makes sense to public or you are out. We need the science to get people on board but we also need the market to be simple so people understand it. Mitigation banking is getting into complicated modeling. On one side, you need to connect to the public, but the landowners cannot complete it themselves; they need the funds to hire consultants to do it for them. What does a farmer do when they take out a loan and the project does not move? They need help to market themselves.

PARTICIPANT

- The comments about appraisal are interesting. Appraisals are not perfect, but you at least have the ability to go to appraiser and say, "I want to look at comparables." At least there is transparency and you can negotiate with the seller. I like this because you can pull the curtain back and negotiate. Keeping the transaction cost low is important or the person will not sell.

MR. BATKER

- Exactly right! Exxon purchased Mobile and in the process, the appraisals were different, but they negotiated and came to a conclusion. All markets are different and have different standards. For FEMA, it does not matter how or where you lost water, they compensate everyone, no matter the circumstance, US $46/day. FEMA's valuation is the same no matter what, which may not be accurate, but it is what they do. Keeping in line with this, we are trying to fit FEMA's model and increase that value by 15%, which is huge! We know we cannot influence what they do and how they do it, but we think we can work with them to improve how they do what they do.

MR. BAYON

- To add to the idea of comparables - That is exactly what we need and what we are trying to do. We trying to generate more comparables.

MR. DAVIS

- This is why the wetland law in the U.S. is valuable, even if it is archaic. The law has over 20 years of history and examples. They are public records that are more or less accessible. It is a working model and as imperfect as it is, it provides those comparables, which are important.

MR. BAYON

- The value of a pilot study is going to be its future as a comparable.

Question 3

Adam and David – One of the goals people have around ecosystem services is to redirect the trajectory around activities. We do not want to just allow development to occur wherever. We want to be able to say watershed A has higher value than watershed B, so do not develop watershed A. Is that taking place in the mitigation paradigm? How do you get to where you redirect the frame?

MR. BATKER

- From our perspective, land use drives all. How do you map ecosystem services on the landscape? You start laying the maps of flood protection, endangered species, storm water, etc., and their values. Each has a map of provisioning benefits. For instance, flood protection is localized while carbon is all over the place. Once that is all laid out, then you can begin to utilize it for land use planning. We are starting to work this way with FEMA. How can you bill and reward based on ecosystem services? The three dimensional map is the impairer: who damaged what? Once you determine who is responsible, then they can pay for it.

MR. DAVIS

- In wetlands markets in the United States, there are two fundamental price signals: 1) a new form of value and 2) price discovery for the damager. Prior to mitigation banking, people would get permits by paying a fee (less than the actual cost) or doing it themselves. Incentive was not great. Now, permits in this new world represent actual cost and incentivize avoidance. As a result, more is happening. Now, the typical exchange is two to three acres of wetland protected for each acre destroyed. What we get in return is

more real protection for something that should be happening anyway. In mitigation, you are moving value, potentially from one place that was not very valuable in the first place. The Mojave energy plan has learned nothing of what we have talked about today and as a result, it is not working. We do not know everything, but we do know some things.

MR. BAYON

- In the United States, you informally do get some thinking and government encouraging places for best mitigation. In Australia, they provide their input/incentives based on a ranking system and have green, red, and yellow areas.

DR. GUILLON

- All the people in wetland and carbon mitigation banking know that you cannot make a wetland impact unless you have looked at 20 other ways. The issue now is not about restoring places to exactly what we had before, it is more about what the most valuable places are, where they are, and how we can protect and restore them.

Question 4

If the ultimate desire is to incorporate true costs into decision-making, we will need regulatory interventions, which set the framework and ground rules for markets. It will also need to be on a global scale to account for leakages. Do you have a point of view on the best and fastest pathway to do this? Is it creating a body of projects with empirical evidence? Is it working with for-profit entities, despite the increased risk, because results and adaptations happen much faster? Or is a combination?

MR. BAYON

- I would say all of the above.

DR. GUILLON

- What you describe is a main issue. You have to get the right players involved early.

MR. BATKER

- It is all three. Policy should focus on policy and rewards. In San Francisco, the chief operating officer is committed, which opens up new avenues for new buyers.
- What is going to pop the cork for wetland finance, enable all of this, and start moving lots of money? We brought many financial officers together who did not know each other and then they realized the watershed was their main asset. When they realized this, they could not understand why they did not see it on their books. How we look at accounting is important to this discussion. Right now no one can write anything about carbon, which the exception of those in Europe. This matters enormously. If a company can show that the river is its asset, then the company can borrow against it. This will begin to move large amounts of money through that asset.

MR. DAVIS

- Great question. How do you move first? If this is it, what is the tactic? Accounting rules are important, but there is also a standoff between policy and finance. Policy has scarce capital right now, both financial and political capital. In the end, the government does not know if it is worth its time. On the financial side, investors want to know that this is not a fad. They need to know the government is serious before they do anything, so there is a real standoff.
- I bet all my chips that by showing a real return on investment, you can get more funds and give people a real reason to participate. Examples are emerging. In New Mexico, a state pension fund hired a consultant to tell them where to invest. The recommendation was to invest in
    - Timber;
    - Domestic Agriculture; and
    - Mitigation Banking.

  In this scenario, mitigation banking is a very new recommendation! This example is quite profound.

MR. BAYON

- There are multiple leverage points. One of which is the accounting standard. If someone wants to invest in ecosystem services, what box does it go in? When the box is there, that will be huge.
- In Europe, they created a carbon market and it crashed the first year. The investors went to the government to get the market up and running because they wanted to earn their money back. That is an example of investors pushing policy. Once carbon had a value, it started showing up on their budgets. These things are mutually reinforcing. Having pilots and the corresponding enabling policy will be important.

Question 5

We do a lot with insurance companies. We are working with Driscoll's on water sustainability and the transfer from the local to the international scale. I am thinking about the FSC forestry model in terms of carbon and water. How do you get certification involved? If you can affect one area, you have the influence to affect other areas. Certification is something we think about, so how does it play?

MR. BAYON

- There are many certification standards out there: LEED, Life Cycle Initiative, etc. There is movement form Rainforest Alliance to incorporate more carbon. In Brazil, the Life Cycle Initiative is showing biodiversity footprints and how to compensate for negative effects. It is starting to happen but it is not at the level where consumers make the decision, in my opinion. The closet thing is Wal-Mart throwing its weight around in its supply chain.

MR. BATKER

- Let me tell you about our work in the spot prawn fishery. They did not end up going with certification, but it was a driver. For certification to work, those involved have to see that they will receive marginal value because of the certification. The producers were refugees from a collapsed fishery and realized they could get more value from crab pot fishing as opposed to trawling. They cared about sustainability of the fishery, but the certification did not matter because they could get more money fishing a different way without the certification.
- Another example is that of electronic waste. Legislation was involved and we started with a pledge to give recyclables to a certified recycler. The certified electronic recyclers really pushed and all of the sudden it went triple digits. In that case, certification worked because the certified businesses saw they could get more business and increase their margin.

MR. DAVIS

- In the wind industry, there is a hybrid world of free compliance. The industry set a goal of providing 20% of America's electricity in a given amount of time. This will require over 20 million acres devoted to wind. If they do this, they will inevitably cause a listing of the lesser prairie chicken. They know this is a real possibility so they are trying to develop a certification standard based on best practices for site selection and operations that will also allow their sites to be grandfathered in as preexisting down the road. To do this, they are working with the Department of Fish and Game. Hybrids are developing.

DR. GUILLON

- How do you explain the value to consumers? You need to explain that you are selling environmental health in a way that justifies the premium. As an international finance corporation, we do it because we are investors but that is not true for the public. Once you demonstrate that the producer could get premium, then the demand for certification will increase. Organics may not last forever, but Fair Trade has a future because it offers (and secures) a premium. These things are all very difficult to convey to customers.

Question 6

The spot prawn is an interesting example of how to incorporate true cost. In effect, the fishermen can have more traps and still have no way to recognize the true cost of fishing. It all gets back to the security of that asset. We have all talked about mitigation banking and land use planning. In other resource areas, it is tricky; you have an issue of political will. How do you deal with it?

MR. BATKER

- Marine paradigm is incredible because it is so hard to tell what is there. You need lots more information on sustainability, economic efficiency, and fairness. You need to know general information about the stock of resources, show that fishermen can make a profit

by participating in certification, and a way to level the field. Individual Transfer Quotas (ITQs) can introduce the risk on monopolization if someone can afford to purchase all ITQs. For this, you need to define limits.

- There is really a great deal of creativity behind the spot prawn example. No one knows how many spot prawns exist, so how do you get the basic information about the asset? The spot prawn is an interesting creature: populations begin all male and then some become female, which adds an entirely new element to management. Canada came up with an interesting solution: when all females are gone, they close the fishery. This is a stock-independent fisheries model.
- Everyone who touched spot prawn made more money through their participation. It is a very specialized markets and not the solution for all shrimp fisheries but may be expandable. Every case is different and they all need case-by-case considerations.

Seminar

6

Ecosystem Services in Practice:

Management Decisions in the Public Sector— From Theory to Application

Speaker

Heather Wright · Dr. Carl Shapiro · Dr. Lydia Olander · Dr. Mary Ruckleshaus

GORDON AND BETTY MOORE FOUNDATION

Ecosystem Services and Public Sector Decision-Making

Introduction and Conclusion by Heather Wright, Gordon and Betty Moore Foundation

INTRODUCTION

Given the magnitude of the impact of global climate change and other human activities on our natural systems, there is a critical need for governments to support sustained and continued ecosystem benefits and to create incentives to maintain environmental capital. Traditionally, economic development goals have depended heavily on ecosystem services, but economic development activities tend to ignore the welfare of those ecosystems and thus jeopardize the well-being of people. This neglect of ecosystem services can increase ecological, social, and economic problems at local and global scales over the long term. As a result, long-term sustainability goals may be foregone for short-term economic wins. Linking policy and/or management objectives to ecosystem service objectives should and can be done in a way that aims to maximize economic, ecological, and social outcomes. To this end, decision-makers need to deliberately take into account the connections between development, ecosystems, and services provided.

This particular seminar is devoted to looking more closely at how ecosystem services are considered in public sector decision-making. The examples showcased explore current ecosystem service approaches that are being applied in the public sector, and examine the rationale and incentives shaping management decisions. They also elucidate the key successes and shortcomings of their implementation. As demonstrated in the following cases, a pure command-and-control approach to mitigation is evolving into policies with a market-like mechanism (e.g., water funds, mitigation banks). This makes an informed public sector even more important, as to date effective markets for ecosystem services are almost always associated with public policy or a regulatory framework.

For example, the active carbon trading market in Europe (European Union Emission Trading Scheme or EU ETS) is a result of the greenhouse gas limitations set in the Kyoto Protocol. And as seen in the North Carolina example in this seminar, wetland mitigation banking is a result of national U.S. policy and regulation under the Clean Water Act (CWA). However, as we have seen in practice, regulation or markets in isolation cannot solve the problem of global ecosystem degradation and the resulting loss of natural resources that we are currently experiencing. The involvement of the public sector is critical to affecting change at scale — from the micro and on-the-ground decision-making processes (e.g., in the coastal British Columbia case) to the meso, with subnational and national policy decisions (e.g., North Carolina's wetland mitigation program), and ultimately to macro policy scales that deal with transboundary and international policy issues (e.g., the Kyoto Protocol).

The case studies that follow underpin the notion that an ecosystem services approach is predicated on good governance, which is key to achieving an effective outcome. This is corroborated by researchers at the World Resource Institute (WRI), who agree that governance — regarding who is making the decision, the process by which the decision is made, and the information and data used to rationalize that decision — is core to an ecosystem approach. The United States Geological Survey (USGS) case study emphasizes this point as it lays out the needs and the framework required to implement an approach that considers ecosystem service science within an adaptive management construct. The cases in British Columbia and Colombia describe the governance and institutional structures that have operationalized their ecosystem services work and clearly linked it to relevant and timely policy questions — another key to successful implementation of an ecosystem services approach. Finally, the North Carolina wetland case study focuses on an ongoing ecosystem services approach to mitigating environmental damage that is being adapted real-time in parallel with an existing policy framework.

As evidenced by these examples and highlighted in other seminars, efforts like the Natural Capital Project on ecosystem services valuation, the work done by the United Nation's The Economics of Ecosystems and Biodiversity (TEEB) program to make natural capital visible, and WRI's strategy to mainstream ecosystem services in public and private sector decisions (among many others) all provide new methods that decision-makers can use to make clear links between ecosystems and development. As the ability to describe and value the benefits of ecosystem services improves, decision-makers can better balance the trade-offs inherent in public-sector decision-making, and ultimately design and implement policies that sustain these services.

ECOSYSTEM SERVICES IN PRACTICE: PERSPECTIVES FROM THE USGS SCIENCE AND DECISIONS CENTER

by Dr. Carl Shapiro, United States Geological Survey

Overview

The USGS Science and Decisions Center (SDC) was established in 2010 to advance the use of science in resource management decision-making. SDC's efforts focus on research and applications in three "sustainability science" areas: decision science (including adaptive management), ecosystem services, and resilience. Ecosystem services such as water, crop pollination, and carbon sequestration can have tremendous value, but are not always or adequately considered in resource management decisions. As a result, resource management, restoration, and development decisions are sometimes made with only partial information. An important question is what has to happen, scientifically, economically, spatially, and institutionally, to ensure that ecosystem services are more routinely incorporated into decisions? Understanding how to reduce these challenges is critical to SDC's goal of advancing the use of science in resource management decisions in market and non-market situations.

USGS science creates a foundation for the study of ecosystem services. The USGS Organic Act, enacted in 1879, establishes the USGS for the "classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain." In today's terminology, the "products of the national domain" are services of value to humans produced in ecosystems, or ecosystem services.

The National Research Council in 2001 recommended that "USGS should shift from a more passive role of study and analysis to one that seeks to convey information actively in ways that are responsive to social, political, and economic needs," suggesting that USGS should actively use science to inform resource management decisions (Hutchinson et al. 2005).

To do this, three critical issues need to be addressed. First, a common analytical framework is needed to facilitate balanced decisions across natural, managed, and developed systems. Secondly, a structured decision process is needed that allows decision-making with uncertainty and incorporates new information as it becomes available. And third, methods are needed to incorporate resilience, risk, and vulnerability in resource management decisions.

Ecosystem services provide an integrated framework for assessing the consequences of land and resource management decisions on the environment and for evaluating tradeoffs among resource management, conservation, restoration, and development alternatives. This framework is especially important when assessing the impacts of dynamic systems caused by climate change, human settlement, and other drivers. Because ecosystem services can be expressed in terms of monetary or non-monetary values rather than only as ecological or physical values, they can be evaluated and compared in different spatial or temporal settings.

Adaptive management, or the use of learning-based management, provides a structured decision process for iterative decision-making when scientific uncertainty exists. Adaptive management facilitates near-term decision-making even when there is imperfect information about longer-term consequences. The integrated conceptual framework provided by ecosystem services can be important to an adaptive management decision process by contributing to the articulation of objectives, the assessment of potential management strategies, and the evaluation of management consequences.

Resilience, vulnerability, and risk provide measures of a natural, managed, or human system's ability to sustain and recover from disturbances. These elements can help frame the process of decision-making, and play an important role in assessing the potential consequences of management strategies. In this context, they are directly connected to both ecosystem services and adaptive management, and are used to describe and define sustainability.

Understanding the value of information is important to assessing the impact of additional information on decision-making. When making resource management decisions, it is critical that the benefits of additional information are understood so that scarce resources can be used effectively. The value of information provides a guide to prioritizing alternative investments in science so that uncertainty is reduced and relevant information is available to support informed decisions.

Moving Forward

Several outstanding questions need to be addressed to ensure that ecosystem services and their values are more routinely incorporated into sustainable resource management decisions. The answers to these questions will allow the impacts of decisions across natural, managed, and human systems to be more completely understood.

- What scientific information and what level of certainty is needed to provide a foundation for resource management decisions and for effective markets?
- How can we value ecosystem services, and what level of certainty is needed so that the calculated values are internalized in decisions?
- What institutional structures most effectively advance the routine consideration of ecosystem services?
- How can we address spatial issues related to ecosystem services flows so that they can be addressed in property rights?
- How can ecosystem services markets be structured so that price can be market-determined and provide a meaningful signal about the value of the service?
- How can metrics for resiliency be developed so that we understand the ability of natural and managed systems to recover from sudden and/or severe shocks, and so that the production of ecosystem services is sustainable?
- How can the value of scientific information be more effectively determined and used to prioritize the science needed to better understand ecosystem services and to inform sustainable resource management decisions?
- How can we more effectively communicate the concept of ecosystem services to technical and lay audiences?

References

Hutchinson, D., R. Sanders, and T. Faust. 2005. *Making U.S. Geological Survey information effective in the electronic age.* U.S. Geological Survey Open-File Report 03-240. http://pubs.usgs.gov/of/2003/of03-240.

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MITIGATION IN TRANSITION: NORTH CAROLINA'S ECOSYSTEM ENHANCEMENT PROGRAM

by Dr. Lydia Olander, Duke University
Incorporating ideas from Bill Holman, Duke University, Martin Doyle, Duke University, and Emily Bernhardt, Duke University

Public policy can have large-scale impacts on how ecosystem services are valued and managed. While environmental laws in the United States have traditionally used command-and-control approaches, revised regulations and state-level implementation are, in some cases, moving toward market-like mechanisms for ecosystem services. These approaches are expected to be a more efficient means of achieving environmental objectives as well as a more cost-effective and flexible means of compliance for those generating the pollution or impacting the environment.

The U.S. Clean Water Act (CWA) is designed to protect streams and wetlands and the services they provide. The implementation of the stream and wetland mitigation program under the CWA is one example where public policy has already shifted toward a market-like mechanism on a large scale. While there are definitely benefits to this transition, it is not achieving all the hoped-for environmental benefits. There are a number of lessons to be learned from the implementation challenges observed as the U.S. considers expanding market-like approaches in other realms of public policy.

Overview

This case study will focus on one example of implementation under the CWA: the wetland and stream mitigation program in the state of North Carolina, also called the Ecosystem Enhancement Program (EEP). This program went from a heralded example of good public policy to a program scrutinized by the press and forced to undergo significant review and revision. This discussion will cover the administrative problems faced, the transition to more market-like approaches, limitations to scientific foundations, and ideas for moving forward. Many of the issues affecting the North Carolina program can be found in mitigation programs across the United States.

Enabling Conditions

Wetland and stream mitigation programs in the United States developed under Section 404 of the CWA of 1977 require permits for placing dredge or fill materials into federal navigable waters, with exceptions for agriculture and other specified uses (33 U.S.C. § 1344). Most development activities that impact streams and wetlands fall under this rule and require a permit from the Army Corps of Engineers (Corps), which administers this program with oversight from the U.S. Environmental Protection Agency (EPA). Implementation involves rules that require the permittee to first avoid impacts, then minimize unavoidable impacts, and then finally to provide compensatory mitigation for unavoidable impacts (Hough and Robertson 2007; 33 U.S.C. § 1344).

In the mid-1990s, wetland mitigation programs in the United States began transitioning from a relationship between developers and regulators, often using onsite mitigation, which resulted in poor-quality mitigation, to one where third parties—state agencies, nonprofit organizations like land trusts, or private mitigation bankers—began developing off-site wetland and stream mitigation projects and banks to be used for compensatory programs.

Discussion of Outcomes

The North Carolina Department of Water Quality and the Corps began to regulate impacts to wetlands and streams in the 1990s. As enforcement strengthened, few private mitigation banks were available, causing costs and delays to highway construction and other development projects. The North Carolina EEP was developed in 2003,[1] bringing together the state Department of Transportation (DOT), the Department of Environment and Natural Resources (DENR), and the regional office of the Corps to share information, improve planning, and initiate an in-lieu fee program in which DOT could pay a fee to the EEP to provide mitigation for impacts. Private developers were later allowed to use this in-lieu fee program as well.

The EEP program covers state and federal compensatory mitigation for streams, wetlands, riparian buffers, and nutrients. It is one of the largest wetland and stream mitigation programs in the United States (Madsen et al. 2010). The program currently has over 560 projects covering more than 600 miles of streams, 30,000 acres of wetland, and 1,200 acres of buffers, and has resulted in zero delays to DOT projects (N.C. Department of Environmental and Natural Resources 2012). The program shifted liability for restoration projects from the transportation agency to an environmental agency, and earned recognition in 2005 and 2007 as one of the top 50 innovative new

[1] The EEP replaced the North Carolina Wetland Restoration Program (WRP), which was established by the state's General Assembly in 1996.

government programs in the nation by Harvard University's Kennedy School of Government.[2] While this suggests a regulatory and administrative success, such accolades preceded actual results from the program, and indeed the program has been beset by significant administrative issues and environmental limitations, most of which have commonalities with other compensatory mitigation programs across the United States and provide lessons for other ecosystem services programs.

The state faced problems commonly found in in-lieu fee programs (Wilkinson et al. 2006). Damages to wetlands and streams were occurring, and fees were being paid, but mitigation was delayed, leading to long lag times—sometimes more than a decade—between ecosystem services losses and replacement (Kane and Raynor 2011a). Fee prices were set politically and were based on least-cost projects—too low to develop high-quality projects, compensate for project risks, support long-term stewardship of restoration sites, or follow through with robust monitoring. In fact, prices were set below the price actually needed to cover the costs of projects. Fee prices should be set sufficiently high to be a disincentive for damaging streams and wetlands that have functions that are difficult or very costly to replace. The result of pushing for lowest-cost solutions may be that damages to highly productive systems are replaced by low-cost and lower-functioning systems. Low prices also undercut the potential for a private market of mitigation bankers that would have developed projects pre-impact.

Because North Carolina has small service areas (the areas adjacent to damages in which mitigation must take place) for compensatory mitigation, the land the state used for mitigation projects—low-cost land in rapidly growing urban areas—was often public lands such as parks. This meant that public funds for parks were subsidizing development projects and their damages to the environment. This has resulted in a pattern of small, scattered projects in suburbanizing areas. While not ideal for wildlife support, these wetlands may have local water-quality benefits.

In contrast, private banking tends to build large projects in outlying areas, where land is cheaper. This can be better for wildlife services but leads to a shift of wetland and stream services from urbanizing areas to rural edges (Womble and Doyle 2010). In terms of optimizing ecosystem service replacement, the program would probably benefit from a combination of project types, to provide a range of services comparable to the services damaged or lost.

Another problem for the EEP was that contractors were not held liable for failure in the wetland or stream construction, which increased the burden on the state program (Kane and Raynor 2011a). Many of these issues have been partially addressed by a new law passed in 2011 (Kane 2011; General Assembly of North Carolina). Mitigation banks must now be used for private impacts where they exist (DOT can still use EEP even where banks exist), mitigation must be in the ground before impacts occur (seven years in advance), and EEP now has more flexibility in how fees are set.[3]

It also became apparent that the politics and incentive structure for the EEP were flawed, with DOT demands for timely, low-cost road construction the first priority and replacement of ecosystem damages secondary. There was little transparency and oversight in this system, which led to the only documented case of double-dipping, meaning that the same service was sold twice, in ecosystem services markets in the United States (Cooley and Olander 2012). In 2000, a company developed a project in eastern North Carolina to sell wetland and stream credits to DOT to offset impacts to wetlands and streams from road-building projects. In 2009, this company sold water-quality credits from the same project—without performing any additional management activities—to the EEP to offset nitrogen impacts to the Neuse River Basin (Kane 2009). According to local experts, if all other existing, already-sold mitigation sites in North Carolina were allowed to stack nitrogen credits, the market could be flooded with 1.1 million pounds of nitrogen credits, exceeding all credits generated since the program began in 2001 (Doyle and BenDor 2009).

The state proposed a rule that would completely disallow such trades (N.C. Division of Water Quality 2012b), but the rule has yet to be finalized. Many of these administrative problems may be fixable with a little political will. In North Carolina, new regulations are starting this process. It is not clear where this will lead, but other states have abandoned in-lieu fee models in favor of market-driven models.

Whether policy moves toward markets or maintains the fee structure, the scientific foundations for such programs still remains an issue. The fundamental question is whether the wetland and stream mitigation projects intended to replace ecosystem functions are working. The most simplistic assessment is whether the area of wetland lost and stream damaged equals the area restored and created. Given delays in construction, failures in projects, and limits to monitoring data, the answer may be no. State records show that more than 30 stream restoration projects totaling more than US $30 million have failed over the last decade (Kane and Raynor 2011a). This represents more than 30% of all stream restoration completed over this time.

[2] Innovations in American Government Awards committee, sponsored by the Ash Institute for Democratic Governance and Innovation at Harvard University's Kennedy School of Government, and the Council for Excellence in Government in Washington, D.C.
[3] Fees are still subject to review and revision by State legislature.

A more important question is whether lost ecosystem functions are being restored. It is clear that the metrics used to track success have been more structural (e.g., wetness of a wetland, shape and stability of stream banks, appropriate plant species growing) than functional (e.g., nutrient cycling, sediment storage, food web health). These functions have not been measured in the wetlands and streams lost, nor in those restored or created, but new methods and metrics, such as the North Carolina Wetland Assessment Method (NC WAM), which is designed to assess three wetland functions—hydrology, water quality, and habitat—are under development to try to better estimate functional equivalence (N.C. Division of Water Quality 2012a).

Even with improved methods there are limits and constraints on the functions restored systems can provide. Studies in North Carolina suggest little improvement from stream restoration, and in some cases declines in sensitive insect taxa (Penrose and Rozelle; Violin et al. 2011); similar results have been found elsewhere (Sundermann et al. 2011). A study by Sudduth et al. (2011) suggests that one of the problems with restoration, at least in the short term, is the clearing of stream-bank vegetation, which leads to significantly higher stream temperatures. One study of a large wetland restoration project that converted agricultural lands back to wetlands in the coastal plains of North Carolina found shifts in nutrient forms and types rather than reductions of nutrient flows (Ardón, Morse et al. 2010 and Ardón, Montanari et al. 2010). The ecological implications of this are not yet clear. One concern is that if ecosystem services and functions are not truly being restored by these programs, the political willingness to spend resources on them will wane.

Moving Forward

Moving forward will require an intentional strategy to build a sound scientific basis for mitigation and integrate this science into policy and market design. A fundamental issue that science is beginning to address is how piecemeal restoration on available or low-cost lands, which are often embedded in highly impacted environments (e.g., urban and agricultural lands), can replace the functions of a large-scale system of wetlands and streams (Sudduth et al. 2007; Bernhardt and Palmer 2011).

Ideally, mitigation programs would be embedded in broader watershed-scale strategies that connect the scale, location, and types of damages to the real costs of restoration, which would help limit impacts to those that are reasonable to replace. The scale, location, and types of restoration would be selected to ensure restoration of lost functions. Such a watershed-scale strategy would ideally connect the many programs and decision-making processes that impact watershed function and ecosystem services.

In addition to the CWA 404d mitigation program, this could include programs that require reductions in nutrient loading, stormwater management (including impervious surface restrictions), and flood control, all of which are managed through numerous federal agencies (Corps, EPA, U.S. Fish and Wildlife Service, Federal Emergency Management Agency), at multiple levels of governance (municipal, state, federal) and across a wide range of administrative programs (water quality, water quantity, risk management, zoning, parks). Under this new paradigm, all impacts to a watershed (e.g., wetland, stream, buffer, impervious surface) would be minimized, avoided, and if necessary, mitigated by an offset in the watershed that would replace lost services.

North Carolina may be a good place to test such a paradigm. Scientists in the region have studies under way to answer some of the fundamental questions about which types of wetlands in which locations provide which services, and whether and how to conduct stream restoration. State officials have expressed interest in more coordinated planning across programs. One example of such coordination would be to link the State Clean Water Management Trust Fund, Parks and Recreation Trust Fund, Natural Heritage Trust Fund, Farmland Preservation Trust Fund, floodplain buyout funds, EPA 319 funds, EEP, and local programs, such as the Upper Neuse Clean Water Initiative funded by Raleigh and Durham water customers. It is possible that such coordination could increase the efficiency of state programs, producing more value per dollar spent in terms of ecosystem services by creating synergies among priorities and avoiding significant tradeoffs.

In summary, while this case study explores the particular example of how national policy was implemented in North Carolina's wetland and stream mitigation program, most of the lessons learned are relevant for other mitigation or ecosystem services programs. A number of the lessons are those of basic good governance, such as the need for transparency and oversight, particularly where the government is tasked with multiple priorities, such as the need to support both economic development through new built infrastructure and the economic and social benefits of natural infrastructure. The shift toward market-like mechanisms and private banking in North Carolina can improve mitigation outcomes because the rules and oversight for private mitigation banks are more stringent, and free up private capital to generate pre-impact mitigation at the scale needed for development.

The shift toward private banks in North Carolina could reduce the use of public lands and hidden public subsidies, but also may move mitigation toward large-scale projects in more rural areas, reducing small-scale urban mitigation, which has pluses and minuses. The potential growth of market-like programs for a range of ecosystem services has raised concerns about stacking payments or double-dipping. It is a complex issue but can likely be managed through careful program design and coordination across programs (Cooley and Olander 2012).

Mitigation programs under the CWA establish a framework for maintaining ecosystem services that can achieve significant scale and bring private investment to bear, but weaknesses remain that need to be addressed. Watershed-scale approaches to improve ecological outcomes and efficiency of investments will require coordination across agencies, regulations, and jurisdictions, as well as advancements in restoration science. The evolving state of the science of stream and wetland restoration (Palmer and Filoso 2009), as well as of other ecosystem services, need not hinder development of ecosystem-based programs and markets, but rather, indicates the need for adaptive policy design that can incorporate new knowledge to improve outcomes over time in a transparent and consistent manner that will not increase risks for program participants and investors.

References

Ardón, M., S. Montanari, J. L. Morse, M. W. Doyle, and E. S. Bernhardt. 2010. Phosphorus export from a restored wetland ecosystem in response to natural and experimental hydrologic fluctuations. *Journal of Geophysical Research* 115.

Ardón, M., J. L. Morse, M. W. Doyle, and E. S. Bernhardt. 2010. The water quality consequences of restoring wetland hydrology to a large agricultural watershed in the southeastern coastal plain. *Ecosystems* 13(7):1060–1078.

Bernhardt, E. S., and M. A. Palmer. 2011. River restoration: The fuzzy logic of repairing reaches to reverse catchment scale degradation. *Ecological Applications* 21(6):1926–1931.

Cooley, D., and L. P. Olander. 2012. Stacking ecosystem services payments: Risks and solutions. *Environmental Law Reporter* 42:10150–10165.

Doyle, M., and T. BenDor. 2009 December 16. Stream restoration: Who really benefits? *News and Observer*.

Hough, P., and M. Robertson. 2007. Mitigation under Section 404 of the Clean Water Act: Where it comes from, what it means. *Wetlands Ecology and Management* 17(1):15–16.

Kane, D. 2009 December 8. EBX is paid twice for wetlands work. *News and Observer*.

Kane, D. 2011 June 19. Legislature OKs rule on streams. *News and Observer*.

Kane, D., and D. Raynor. 2011a April 17. State spends $140 million on faulty water projects. *News and Observer*.

———. 2011b April 20. For state streams, restoration just starts the costs. *News and Observer*.

Madsen, B., N. Carroll, and K. Moore Brands. 2010. *State of biodiversity markets report: Offset and compensation programs worldwide.* Ecosystem Marketplace. http://www.ecosystemmarketplace.com/documents/acrobat/sbdmr.pdf.

N.C. Department of Environment and Natural Resources. 2012. Website. http://portal.ncdenr.org./web/guest.

N.C. Division of Water Quality. 2012a. *N.C. wetland assessment method (NC WAM).* http://portal.ncdenr.org/web/wq/swp/ws/pdu/ncwam.

———. 2012b *Riparian buffer rules.* http://portal.ncdenr.org/web/wq/swp/ws/401/riparianbuffers/rules.

Palmer, M. A., and S. Filoso. 2009. Restoration of ecosystem services for environmental markets." *Science* 325:575–576.

Penrose, D., and L. Rozelle. *Aquatic insect responses to stream restoration. How do we define success?* Poster.

Sudduth, E. B., B. A. Hassett, P. Cada, and E. S. Bernhardt. 2011. Testing the field of dreams hypothesis: Functional responses to urbanization and restoration in stream ecosystems. *Ecological Applications* 21:1972–1988.

Sudduth, E. B., J. L. Meyer, and E. S. Bernhardt. 2007. Stream restoration practices in the southeastern United States. *Restoration Ecology* 15(3): 573–583.

Sundermann, A., S. Stoll, and P. Haase. 2011. River restoration success depends on the species pool of the immediate surroundings. *Ecological Applications* 21:1962–1971.

Violin, C. R., P. Cada, E. B. Sudduth, B. A. Hassett, D. L. Penrose, and E. S. Bernhardt. 2011. Effects of urbanization and urban stream restoration on the physical and biological structure of stream ecosystems. *Ecological Applications* 21(6):1932–1949.

Wilkinson, J., R. Thomas, and J. Thompson. 2006. *The status and character of in-lieu fee mitigation in the United States.* Washington, DC: Environmental Law Institute.

Womble, P., and M. Doyle. 2010. Setting geographic service areas for compensatory mitigation banking" *National Wetlands Newsletter* 18:18–23.

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IMPROVING CONSERVATION INVESTMENT RETURNS FOR PEOPLE AND NATURE IN THE EAST CAUCA VALLEY, COLOMBIA

by Dr. Mary Ruckelshaus, Natural Capital Project

Overview

Water is one of the scarcest resources on the planet, and pressures on this vital form of natural capital will only grow as the human population expands and climate changes. Latin America is making a major effort to address this issue by improving the management of watersheds, the green infrastructure that supplies, regulates, and cleans water. In June 2011, the Inter-American Development Bank, the Global Environment Facility, and FEMSA (a large beverage company) committed US $27 million to developing 32 new water funds across Latin America in the next 5 years. Figure 14 shows some of the planned water fund areas, which include water sources for many of the continent's largest cities and some of the most important remaining intact habitats.

The Natural Capital Project (NatCap) works with decision-makers to understand their policy or management objectives, and how information on ecosystem service values can help. We work with our partners in each decision context to scope the issues and identify how accounting for ecosystem service values will inform their specific policy or management interventions. The partners define the specific management questions, timelines over which scientific outputs are needed, and the most useful types of outputs (e.g., maps, tables, simple graphics.) The NatCap team works iteratively with the decision-making partners to refine analyses and ways of presenting results so that the science is clear and most relevant to their decision context.

Figure 14: Some of the 32 areas in Latin America where new water funds are planned. *Source: The Natural Capital Project.*

THE SCIENCE-POLICY PROCESS

While the idea of water funds is garnering international investment interest, there are still important scientific advances to be made in their design and implementation. For example, most existing water funds make investments on an ad hoc basis, offering incentives to anyone who will participate. In many cases, this approach is not likely to give the fund the best return on investment in terms of reaching project objectives for protecting biodiversity and improving or safeguarding ecosystem service flows.

NatCap has worked with the Water for Life and Sustainability water fund (red star in the map above) in the East Cauca Valley of Colombia to try to improve the fund's return on investment. Our approach brings ecological and social information to their investment process through a combination of methods, including ecological rankings, local knowledge, stakeholder preferences, return on investment, and ecosystem service modeling. The water fund secretariat identified the specific needs for ecosystem service value information: to help them prioritize *where* to target their investments, identify *which kinds* of restoration and protection activities were most likely to be cost-effective, and then to provide *accountability for testing* future observations against predicted changes in ecosystem service values. NatCap, in turn, provided the ecosystem-service valuation information to inform their prioritization decisions.

SETTING THE STAGE

The Water for Life and Sustainability fund is overseen by the Cauca Valley's sugar cane producers association (ASOCANA), sugar cane growers association (PROCANA), each watershed's local environmental authority, a peace and justice organization, and The Nature Conservancy. The process developed by the water fund and NatCap for determining how investments would be made is shown in Figure 15. The stakeholder groups jointly agreed on the objective to "maintain consistent water flows necessary for drinking water, biodiversity, and agriculture through a coordinated strategy." In the 11 watersheds included in the water fund, investments are made in management changes that improve cattle ranching and small-scale farming practices, the major threats to biodiversity, water supply, and water quality (sediment) in the upper watershed. The activities supported by the fund include protection, fencing, silvopastoral systems, forest enrichment, and restoration. Past experience in the region has shown that these kinds of activities are feasible for landowners, given

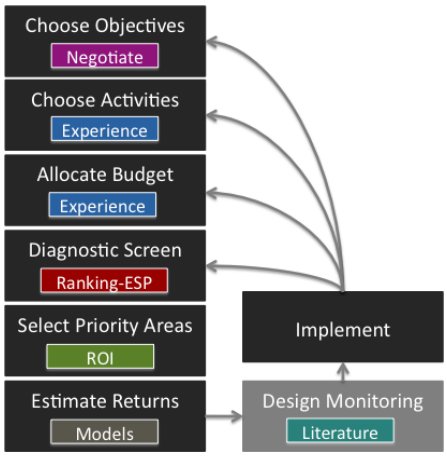

Figure 15: The process for determining investments made by the Water for Life and Sustainability fund. *Source: The Natural Capital Project.*

their likely opportunity costs. The fund committed to investing US $10 million over a five-year period, and this budget in the first few years has been allocated among watersheds proportional to watershed area, and among activities based on the kinds of land use in each watershed.

Discussion of Outcomes

WHERE SHOULD INVESTMENTS BE MADE?

To move beyond the standard approach to water fund investment, we focused in on four watersheds within the Cauca Valley water fund area. We started with a map of where each activity was feasible, based on past experience in the region, and then ranked the landscape to identify areas where each activity was likely to give the best returns in terms of terrestrial biodiversity, erosion control, annual water supply, and dry-season water supply. Rankings were based on literature reviews and, for annual water supply, on model estimates of likely change, using the free GIS-based InVEST model suite (Integrated Valuation of Environmental Services and Tradeoffs). We also asked stakeholders to identify areas in each watershed where they thought activities should be focused, and where water fund investments were not possible because of political instability.

We combined all of this information into one score that showed where each activity was likely to be most effective and socially acceptable in each watershed. Then, to identify which investments should be made first, we used a return on investment approach to select the areas that were likely to give the greatest returns for each activity. Using historic data on the cost of each activity, we selected areas until the budget level was reached. This gave us a final "investment portfolio" map that showed which activities the fund should invest in, and where, in each watershed (see Figure 16).

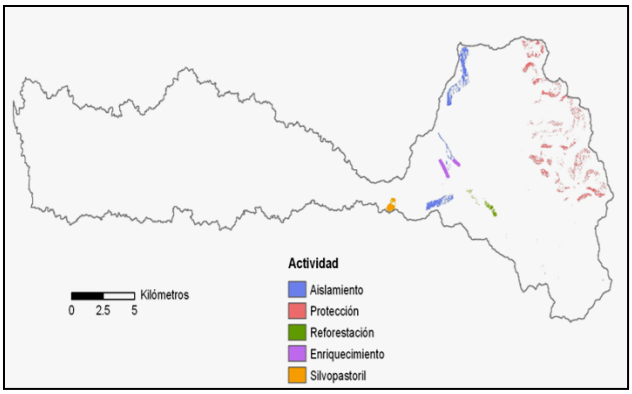

Figure 16: The Cauca Valley investment portfolio map*. Source: The Natural Capital Project.*

HOW MUCH ECOSYSTEM SERVICE CHANGE WILL THE FUND PROVIDE?

Investors want to know how much change they will get from each portfolio of activities. Ideally, we would have local studies that measured the response of biodiversity, erosion, and water supply to each of the activities supported by the fund. This kind of research has not been done in this region, so instead we estimated erosion and annual water yield response (just two of the water fund objectives) using InVEST. The InVEST tool can give fund managers a preliminary estimate of how much return to expect. The panels in Figure 17 how the estimated erosion control benefits for each watershed in the black lines.

There are no observed data on sediment loads in the region, so we cannot yet validate the model, but since we can estimate both current conditions and investment possibilities with the same modeling approach, we can get a relative sense of how much change to expect (percent change) as spending progresses over the next five years. For example, erosion control in the Fraile watershed will likely increase from a 1% benefit in year 1 to a 14% benefit by year 5.

Monitoring of actual changes on the ground is essential to the fund's success. In this case, the water fund is installing a monitoring program to track terrestrial and freshwater biodiversity, turbidity (sediments in the water), and water yield. These measures will show how much change the fund is really effecting, and will help inform adaptive management of where investments should be made. The monitoring can also be used to improve model estimates for further exploration of investment options.

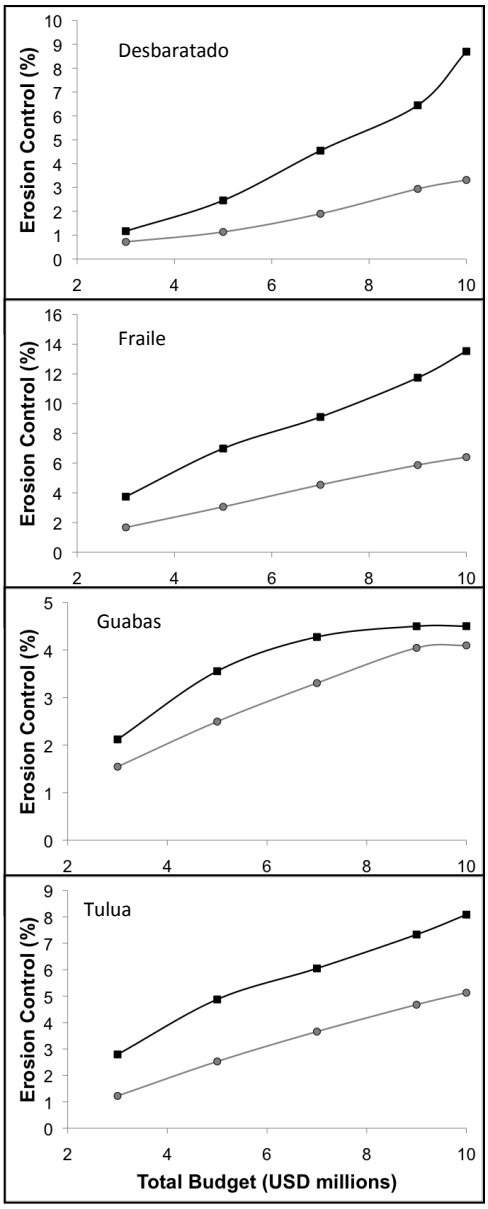

Figure 17: Estimated erosion control benefits by watershed. *Source: The Natural Capital Project.*

DOES THE SCIENCE HELP?

The Cauca Valley water fund secretariat invested extra time engaging with NatCap scientists, and the NatCap team committed significant time and resources to supporting the science-policy process. In short, scientifically targeting water fund investments takes a lot of work. In the end, is it really worth it? We asked this question for the Secretariat, using a metric that speaks to their bottom line: is the return on their investment improved by using a science-based approach to prioritization?

We used a random investment approach that represents well the way most water fund investments are made, and then we asked how the erosion control returns from that approach compared to our targeted approach described above. We used InVEST again to estimate returns, and found overall lower returns in all watersheds (gray lines in the panels in Figure 17). When we used these estimated returns to calculate an estimated return on investment (change in erosion control per dollar spent), we found that using science is likely to double returns. The ratio of return on investment between the two approaches varies by watershed, meaning science is more worth the effort in some watersheds, like Desbaratado (the red bars in Figure 18), than in others, like Guabas (the blue bars in Figure 18).
The four watersheds we analyzed account for about 40% of the budget, so at the total fund level of US $10 million, these watersheds would spend US $4.2 million. Using the targeted investment strategy saves US $3 million in these watersheds at that level of investment. Further exploration of these methods, and the actual measurement of water fund outcomes, will allow us to continue to improve the efficiency of this promising conservation finance strategy.

IMPLEMENTING THE NEW SCIENCE GUIDANCE IN FUND PRIORITIZATION

The modeled ecosystem service maps provided by NatCap and its partners in Colombia are now included in the regular requests for proposals for projects to be funded as part of the fund investments. The priority areas for service provision and restoration that are highlighted on the maps provide information for project proponents and reviewers of proposals, to help guide investments in protection and restoration activities and monitor returns. Families in the watershed comprising the water fund voluntarily opt in to the fund, receiving materials and labor for activities designed to improve water quality downstream (e.g., fencing, riparian planting, different silvicultural practices). For each round of fund investments, the secretariat mails out the NatCap-generated prioritization maps so that families in the watershed can see the priority areas and activities.

The InVEST tool is made up of a number of simple ecosystem service models, and the upside of this simplicity is that data requirements generally are not a limitation of using the tool. The downside is a lack of specificity in predicted impacts of different protection or restoration activities. A primary challenge for the water fund is thus to learn from its experience, testing empirically whether the activities implemented through their program do in fact provide the water quality and other ecosystem service benefits projected in the InVEST model.

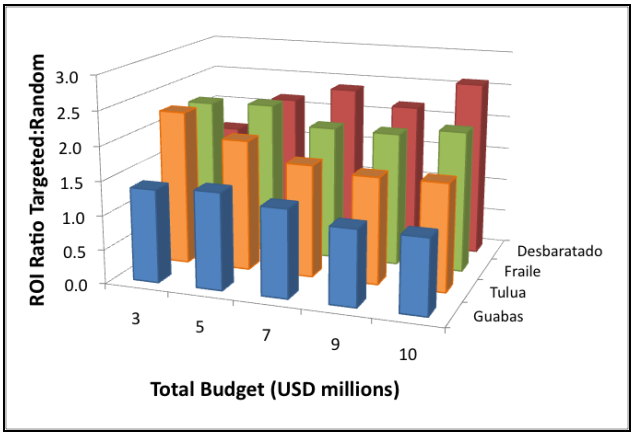

Figure 18: The ratio of return on investment, by watershed. *Source: The Natural Capital Project.*

Enabling Conditions

The Nature Conservancy (TNC) and its local partners in Latin America have been key drivers of the policy processes leading development, implementation, and testing of the water funds. Early successes in the 1990s of the water fund project in Quito, Ecuador, provided momentum for TNC and partners to build upon; this momentum culminated in the spring 2011 announcement of an ambitious policy and decision support platform to establish 32 new water funds in Latin America by 2016. The close partnership between NatCap and TNC provided the needed policy support for an iterative science-policy process through which NatCap trained partners in the use of the InVEST tool, provided scientific guidance and input, and adapted the models and outputs as needed.

The broad and committed leadership by government, private industry, and non-governmental organization (NGO) sectors on the governing board of the water fund ensure that its deliberations and decisions are coherent and consistent with the objectives established by the fund. TNC has been a constant leader and supporter of the water fund process throughout its evolution, and its long-standing presence in Latin America lends it credibility and legitimacy within the region.

Moving Forward

Monitoring and adapting the protection and restoration strategies implemented under the water fund will be key to providing accountability to the investors that the water quality and other ecosystem service returns are efficient and effective. The next exciting opportunity and challenge is to scale up lessons learned from a few existing water funds to develop a standardized approach to implement 32 water funds over the next 5 years. TNC and NatCap will work with government, business and NGO practitioners to design the standard approach so that it addresses the prioritization and accountability needs and concerns of the entities who will be implementing the funds.

The challenges for replicating the science-policy process are twofold: 1) to provide an ecosystem services modeling and decision support tool for prioritizing locations and types of investments that is rigorous and yet simple to use with widely available data, and 2) to design monitoring protocols and analytical approaches for testing the ecosystem service outcomes that allow the funds to be accountable to their investors and beneficiaries, and to adapt their strategies as needed. On the policy front, the challenges are to find a generalizable approach to testing and refining the investments so that ecosystem and human well-being returns continue to be maximized over time.

For more information, contact Heather Tallis (htallis@stanford.edu) or Alejandro Calvache (acalvache@tnc.org).

References

Natural Capital Project. InVEST: Integrated Valuation of Environmental Services and Tradeoffs. http://www.naturalcapitalproject.org/InVEST.html.

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DEVELOPING A MARINE SPATIAL PLAN WITH PARTNERS ALONG THE WEST COAST OF VANCOUVER ISLAND, BRITISH COLUMBIA, CANADA

by Dr. Mary Ruckelshaus, The Natural Capital Project

Overview

Along the west coast of Canada's Vancouver Island, multiple, often competing interest groups have come together to envision the future character of the region and how myriad human uses can co-occur without undermining each other and the marine ecosystem on which they depend. The West Coast Aquatic Management Board (WCA) is helping to achieve this by creating a marine spatial plan for the region. WCA has been cultivating stakeholders in the region for several years, and has developed a positive, personal working relationship with First Nations, local governments, and citizens in the region. They were interested in enlisting help from NatCap to provide independent scientific guidance to inform their process. Marine spatial planning involves using scientific and geospatial information to address conflicts and organize human activities in the ocean, while maintaining ecosystem health, function, and services. In a marine spatial plan, a wide range of allowable uses of the marine environment are incorporated on one map, as depicted in Figure 19 below.

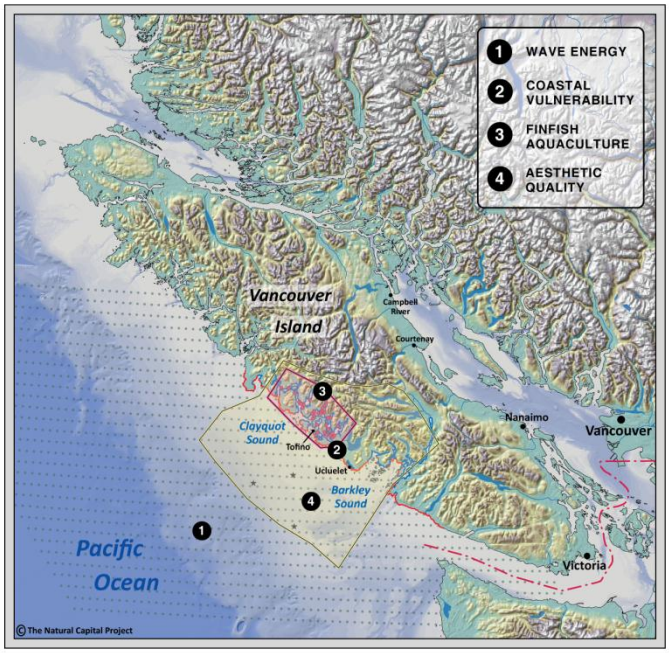

Figure 19: Map of west coast Vancouver Island, British Columbia, marine spatial planning area. *Some of the many ecosystem services we modeled and their general locations are denoted by numbers 1-4 in the map at left. Planning scenarios are being developed and analyzed both at the scale of individual sounds (e.g., Clayoquot and Barkley sounds) and on the broader scale of the entire west coast, where wave energy projects, commercial and recreational fisheries, and wildlife viewing activities occur. Source: The Natural Capital Project.*

WCA is a public-private partnership with participation from four levels of government (federal, provincial, local, and First Nations) and diverse stakeholders. Ultimately, WCA's vision is to manage resources for the benefit of current and future generations of both people and non-human species and their communities. Some key considerations for WCA and its stakeholders include balancing important industrial and commercial activities (such as shipping, mining, logging, aquaculture, and fisheries), increased development of tourism and recreation, renewable energy generation, access to healthy and local seafood, and a strong cultural desire for sustaining the remote, wild feeling of the place. Aesthetic, spiritual, and cultural values — benefits that are not readily quantified — are universally important across the diverse communities.

NatCap works with decision-makers to understand their policy or management objectives, and how information on ecosystem service values can help. We work with our partners in each decision context to scope the issues and identify how accounting for ecosystem service values will inform their policy or management interventions. The partners define the specific management questions, timelines over which scientific outputs are needed, and the most useful types of outputs (e.g., maps, tables, simple graphics.) The NatCap team works iteratively with the decision-making partners to refine analyses and ways of presenting results so that the science is clear and most relevant to their decision context.

What Policy Questions Did the Analysis Set Out to Address?

WCA is working with the NatCap to apply InVEST as part of a four-year marine spatial planning process. WCA is using intensive outreach to engage communities spread throughout Vancouver Island's sparsely populated west coast. It hosted a series of meetings to clarify visions and values of local First Nations and non-tribal communities, and are iteratively developing and getting feedback from communities to the interim results produced by the WCA-NatCap collaboration. The goal of the collaboration is to: 1) assess the suitability of regions for different activities, 2) assess how alternative spatial plans might affect a range of ecosystem services, and 3) identify the marine use conflicts likely to arise from alternative spatial plans, and how they could be avoided or minimized.

Together WCA and NatCap created a large number of spatially explicit scenarios with extensive stakeholder engagement, each representing alternative configurations and intensities of activities on the coast and in the ocean. Since marine spatial planning involves a diversity of decisions made by different industries and government agencies, the team developed scenarios at two spatial scales, local and regional, each with a different mix of stakeholders and uses.

Discussion of Outcomes

TRADE-OFFS IN MARINE USES AT THE LOCAL SCALE

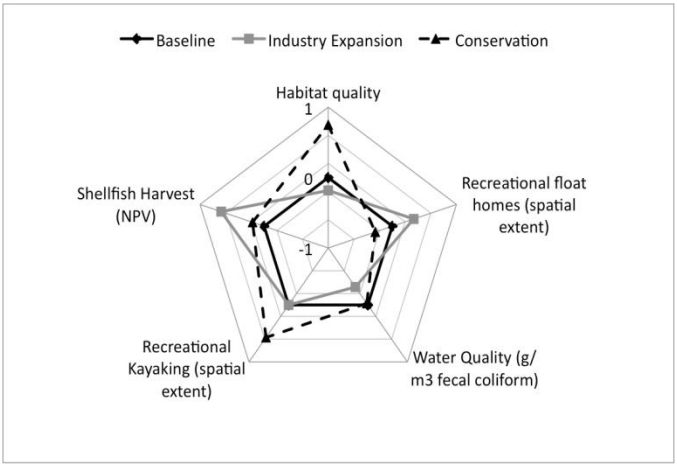

Figure 20: Percent changes relative to current conditions (baseline) in habitat risk, recreational float homes, water quality, kayaking, and shellfish harvest under three alternative management scenarios in Lemmens Inlet, B.C*. In the Conservation scenario, habitat risk is lower due to the relocation and removal of some float homes, while water quality, kayaking, and shellfish harvest all increase to varying degrees. In the Industry Expansion scenario, shellfish harvest and float homes increase, there are no effects on kayaking, and negative impacts on water and habitat quality increase substantially. Note that the axis for water quality is reversed (i.e., points further from the origin have lower concentrations of fecal coliform bacteria and indicate higher water quality). Source: The Natural Capital Project.*

The local-scale scenarios reflected the visions and values of each First Nation and consisted of alternative arrangements of zones for a range of human uses and activities. For example, zones were identified to accommodate important income-generating activities (e.g., finfish farms) as well as cultural and spiritual activities (e.g., culturally managed areas). We used the InVEST tool to model changes in ecosystem services from several local areas. As an example of the kinds of results our process is providing, trade-offs from one such area, Lemmens Inlet, are shown in Figure 20, under three alternative scenarios of human uses and activities.

The traditional territories of nine First Nations bands together constitute all of WCA's planning area; thus, individual First Nation-scale planning is critical to WCA's strategy for marine spatial planning for the region. The Nations have jurisdiction over many activities (e.g., development of tourist facilities, shellfish aquaculture tenures) in their territories, significantly simplifying the planning process. However, other activities (e.g., shipping, renewable energy generation, commercial fisheries) occur at larger scales and require agreement from other levels of government. Layering these activities into the mix necessitates a larger-scale perspective and is more representative of the multi-stakeholder marine spatial planning processes occurring in other regions.

Where Can Commercial and Recreational Activities Avoid Use Conflicts?

The larger-scale scenarios reflect the interests of a much broader range of stakeholders, including industries such as commercial fisheries, aquaculture, and shipping operators. Coastal towns on the island are being approached by wave-energy interests who seek high-energy sites near existing electrical grid points on land. We used InVEST to analyze how the potential siting of wave energy facilities would intersect with commercial and recreational fishing areas along the coast so that spatial conflicts could be minimized. Our analyses highlighted areas of potentially high net present value for wave energy generating facilities that are outside of most commercial and recreational fishing activities, as shown in Figure 21 below. This information will be used in the next phase of marine spatial planning at the larger scales along the coast.

Enabling Conditions

Our primary partner on Vancouver Island, West Coast Aquatic, is a public-private entity with good representation from many government, First Nation, private, and NGO stakeholders in the region. Its leadership of the political process and engagement with different sector groups in the area is critical to the collaboration. Because of the distinct and unassailable property rights and authorities in the region, the science-policy process conducted through our collaboration is essential for illuminating options that minimize conflicts among interests. External funding for science capacity from NatCap to help in designing and evaluating alternative scenarios brings additional technical support to the process.

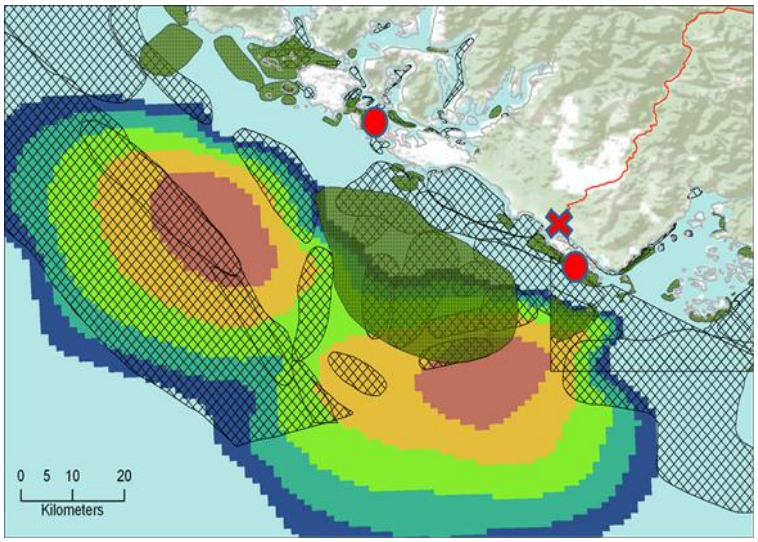

***Figure 21: Potentially high net present value (NPV) areas for wave energy facilities**. Colored contours show NPV estimates of potential wave energy facilities based on captured wave energy, operating costs, and distance to electrical grid (warmer colors have higher NPV). The red line on land shows grid location; red dots show assumed landing points for electricity from facilities. Distribution of commercial crab, salmon, and shrimp fishing grounds (stippled areas) and recreational salmon and groundfish areas (green areas) are overlaid on contours of the NPV of wave energy. Source: The Natural Capital Project.*

Moving Forward

Marine spatial planning processes are a relatively new phenomenon, and have a strong appeal in that they allow stakeholders to incorporate multiple human values and uses into creating a plan for how to allocate space and ecosystem benefits in ways that maximize value and minimize conflicts. Nevertheless, such multi-sector processes are challenging to implement — they require time, a dedication to iterative communications, and the refinement of scientific analyses to support the process.

In this collaboration thus far, we are finding that when tradeoffs are communicated clearly in metrics that resonate with stakeholders (e.g., net present value of the shellfish harvest or bacterial content in water), people are equipped to make their own decisions about which tradeoffs are acceptable and which are not. By using process-based models linked through impacts to habitat and water quality, InVEST allows users to identify unexpected consequences and compatibilities among human uses that could not be gleaned from simple maps alone.

Marine environments are complicated because authority and property rights are often unclear; thus, no single marine planner knows where everything happens on the seascape. The development and implementation of a marine spatial plan requires coordination among many government agencies, First Nations, and private interests. Taking a community-based, bottom-up approach to planning and scenario development takes extensive time and resources, so factoring in realistic timeframes is important for setting expectations of progress.

Aesthetic, spiritual, and cultural values — benefits that are not readily monetized or even quantified — are universally important across the diverse communities in the region. These cultural services are included in the marine spatial planning process in two primary ways: through articulation of acceptable future activities in scenarios (e.g., by excluding or encouraging some activities in areas of spiritual or cultural significance), and through the selection of models to run (e.g., aesthetic values, provision of culturally valuable shellfish landings). Value is not always easily characterized or fully captured in monetary terms, so it is important to characterize value in multiple dimensions, including health, livelihood support, cultural significance, and so forth. This will help ensure that valuation and broader decision-making approaches are inclusive of the range of benefits and people concerned. Interdisciplinary efforts are presently underway to create a conceptual framework that is useful both in theory and in practice for a broad suite of cultural ecosystem services.

For more information, contact Anne Guerry (anne.guerry@stanford.edu).

Recommended Citation:

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CONCLUSION

The suite of concepts gleaned from the public sector and presented in this chapter highlights several key issues and helps to further reveal the underlying technical and political complexity inherent to an ecosystem services approach. First, as previously noted, concrete governance and robust oversight are fundamental to implementing an ecosystem services approach. However, these experiences highlight the need for a robust decision-making framework to be coupled with rigorous science, a clear articulation of policy linkages, economic analyses, benefit-sharing schemes, monitoring and reporting regimes, coordination across agencies, and participation among key stakeholder groups, as well as a comprehensive understanding of any trade-offs involved, in order to deliver effective, efficient, and equitable results on the ground.

In addition, by working within the public sector, this type of framework can be strengthened by decision-makers' abilities to design policy measures that create incentives for large multinational corporations, small businesses, civil society, communities, and individuals to maintain and sustainably manage ecosystem services, as well as disincentives that deter actions that promote widespread ecosystem degradation. Finally, credible and transparent governance structures that support consistent monitoring of biophysical, social, and economic returns can serve to attract investment from the private sector to complement public funds and scale the approach beyond what limited public resources can support (as demonstrated by the development of additional investment in the Colombia water fund's fund structure and in North Carolina's engagement of private banks).

From these case studies, it appears that building a framework to track and manage ecosystem services offers public-sector benefits in terms of management cost savings and public support. For example, Wunder (2009) has identified the following attributes in large-scale, government-led payment for ecosystem services (PES) programs that are relevant to the public sector ecosystem services–focused case studies presented here: lower transaction costs, better links with existing policies, ability to secure greater targeted impacts and multiple benefits, and easier-to-control issues of leakage (leakage occurs when the provision of ecosystem services in one location increases pressures for conversion in another[4]).

Wunder's work highlights key characteristics of public sector ecosystem services efforts that support the case for this approach from an economic, social, and environmental perspective, though it is important to note the need for strong frameworks with clear indicators from which to assess and verify performance and compliance, which in the past have been notably lacking. Ultimately, an ecosystem services approach can help facilitate a global sustainability paradigm shift that depends on investing in ecosystems for long-term social well-being and economic development; however, this effort requires continued improvement and integration from all levels of decision-making to realize the ambitious goal of sustainability.

[4] For example, in the case of deforestation, leakage is the shifting of deforestation activities from one area to another.

References

Wunder, S. 2009. Can payments for environmental services reduce deforestation and forest degradation? In *Realising REDD+: National strategy and policy options,* Angelsen, A., M. Brockhaus, M. Kanninen, E. Sills, W. D. Sunderlin, and S. Wertz-Kanounnikoff, eds. Pp. 213-224. Bogor, Indonesia: CIFOR.

Recommended Citation:

Wright, H. Introduction & Conclusion. "Ecosystem Services and Public Sector Decision-Making." In Measuring Nature's Balance Sheet of 2011 Ecosystem Services Seminar Series. Edited by Coastal Quest and Gordon and Betty Moore Foundation, 410-411,429-430. Palo Alto: Gordon and Betty Moore Foundation, 2012. PDF e-book.

Seminar

6

Ecosystem Services in Practice: Management Decisions in the Public Sector- From Theory to Application

Speaker

Heather Wright · Dr. Carl Shapiro · Dr. Lydia Olander · Dr. Mary Ruckleshaus

2011 ECOSYSTEM SERVICES SEMINAR SERIES

GORDON AND BETTY MOORE FOUNDATION

Ecosystem Services Seminar 6: Ecosystem Services in Practice: Management Decision in the Public Sector – From Theory to Application

Presentation and Discussion Notes From Panelists: Dr. Lydia Olander, Dr. Mary Ruckelshaus, Dr. Carl Shapiro, and Ms. Heather Wright

Seminar Series and Seminar 6 Goals:

The goal of the multi-session seminar is to educate the broader conservation community including practitioners and funders on the diverse aspects of ecosystem services – such as how to account for ecosystem services and to effectively measure, manage, and communicate them.

Seminar 6 and associated readings focused on the following goals:

- *Public sector ecosystem services theory, implementation, and factors shaping management decisions*
- *Lessons from public sector ecosystem services implementation*
- *Public-Private partnerships and ecosystem services*
- *ecosystem services and investment planning*

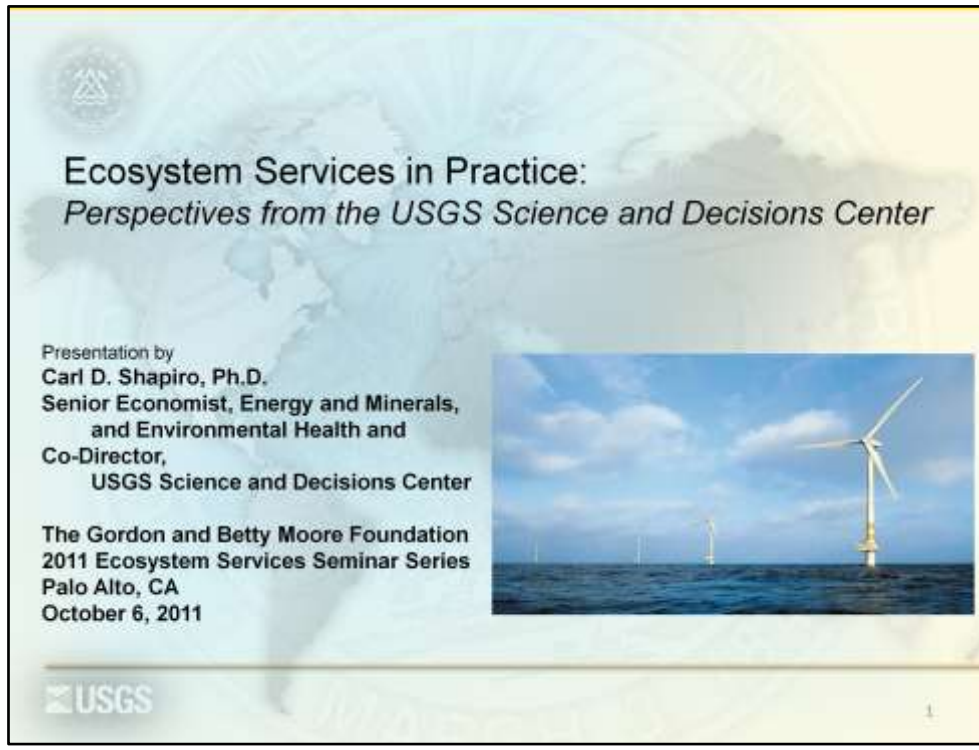
Disclaimer:

This document is a summary that includes PowerPoint slides from the panelists, Dr. Lydia Olander, Dr. Mary Ruckelshaus, Dr. Carl Shapiro, and Ms. Heather Wright, and notes of their talking points. In addition, we provide a synthesis of important questions discussed during Seminar 6. Please keep in the mind that the following document is only a recap of the presentations and Blue Earth Consultants' notetakers have, to the best of their ability, captured the presentations. We hope that the following presentations and discussion notes will be used as resource to advance further discussions about ecosystem services.

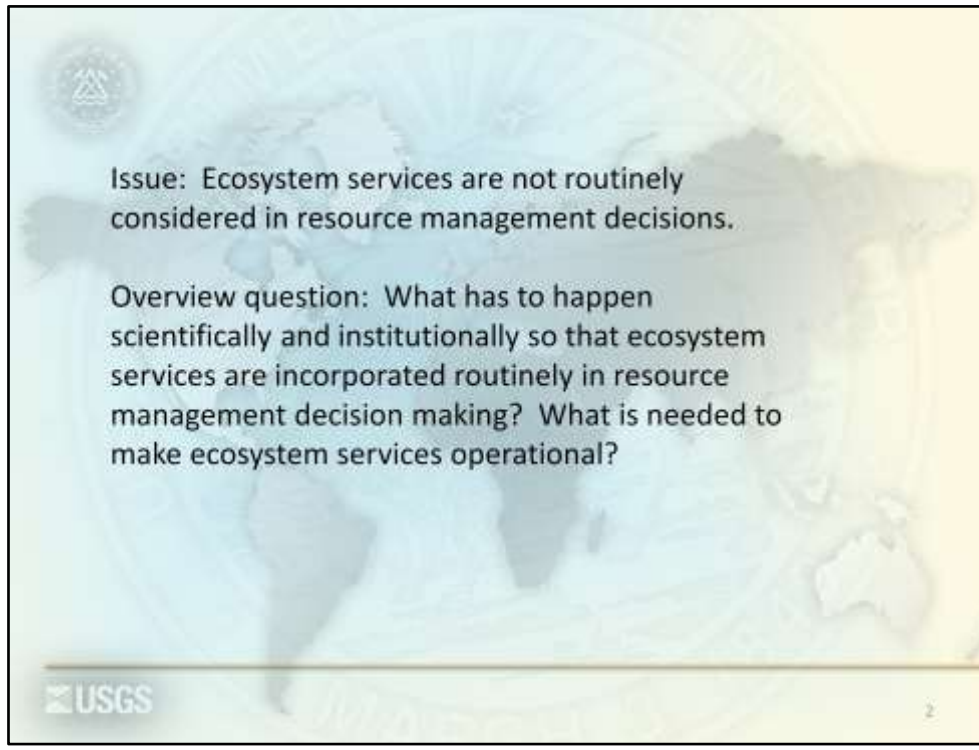
GORDON AND BETTY MOORE FOUNDATION

COASTAL QUEST

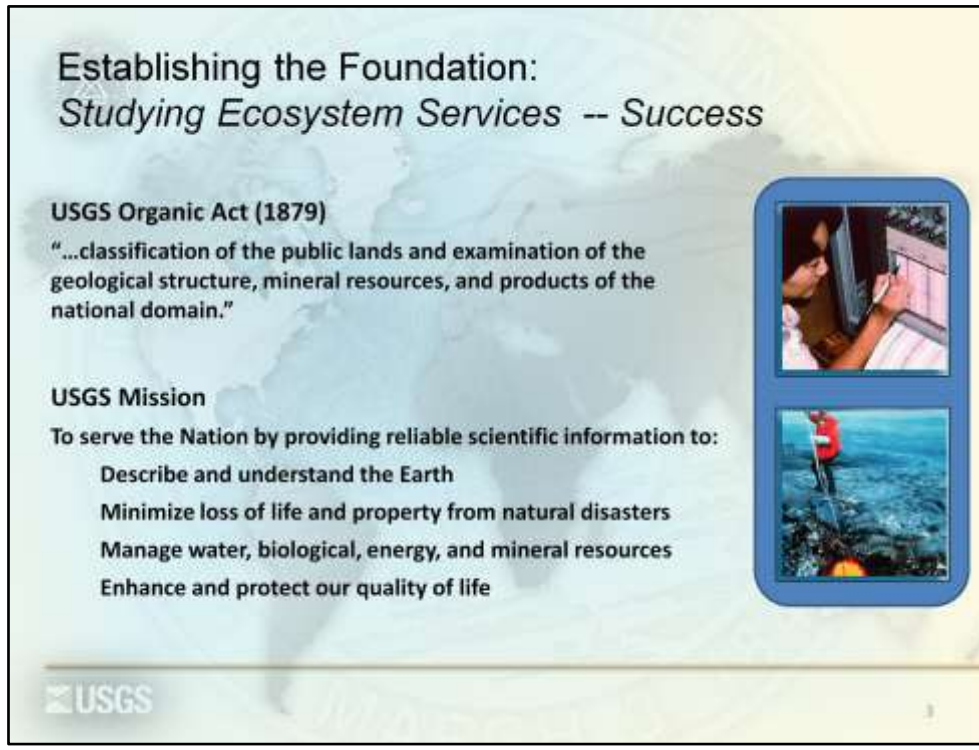
BLUE EARTH CONSULTANTS



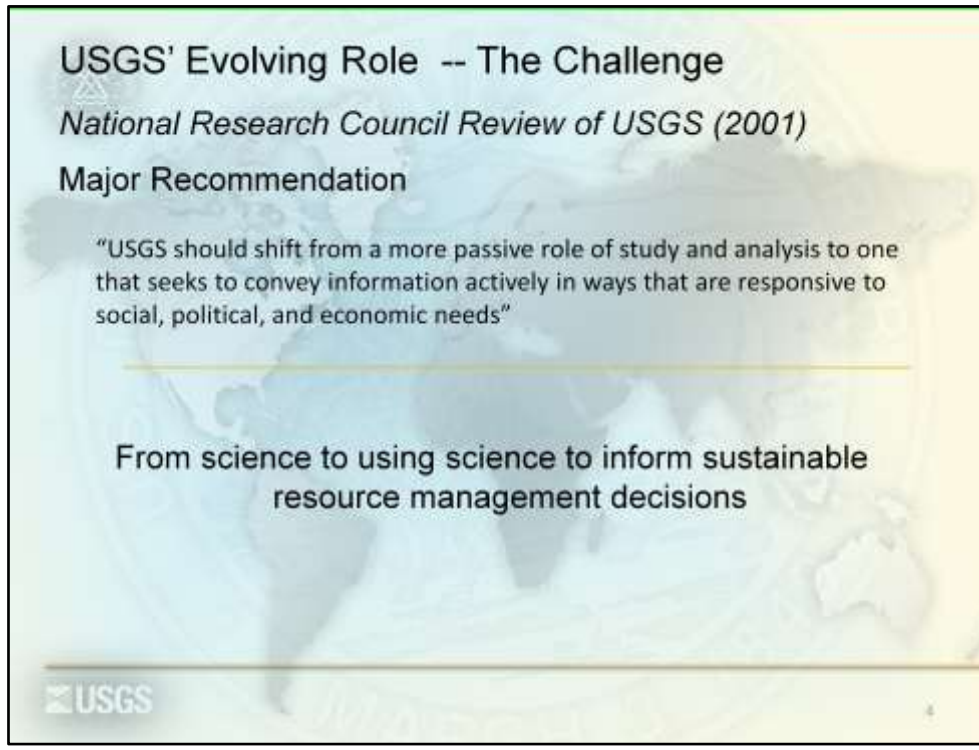
Dr. Carl Shapiro



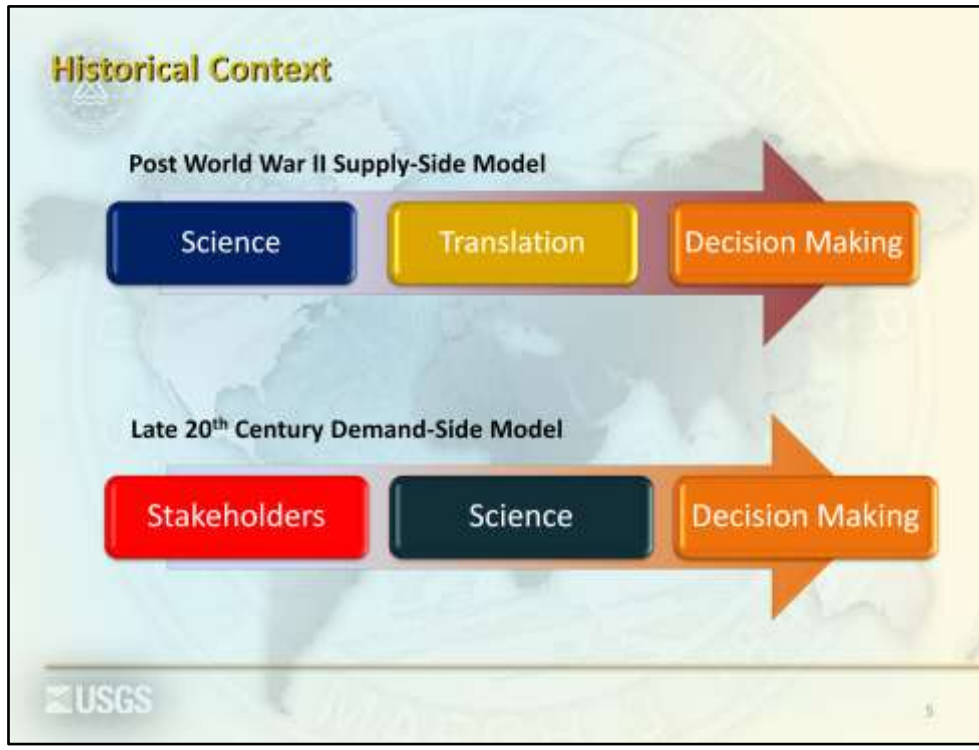
- The basic issue is that we are not routinely considering ecosystem services (ES) in resource management decisions. We face a huge challenge to figure out a way to do this.



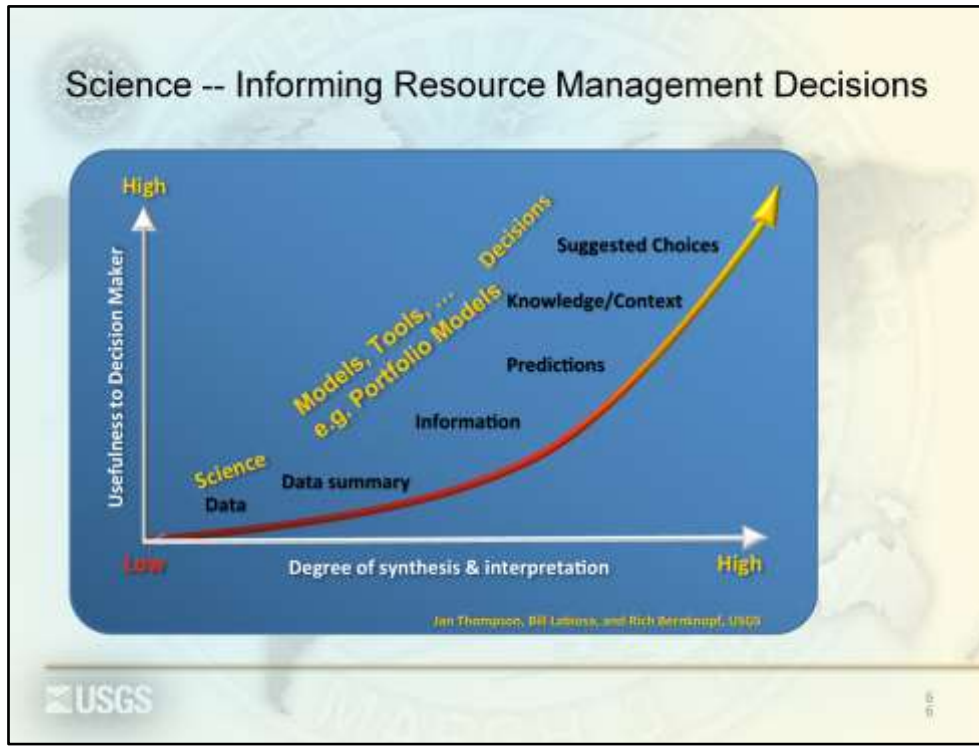
- I will speak today from a United States Geological Survey (USGS) Science Center perspective where we have been conducting a lot of science related to ES.
- The USGS's consideration for ES is apparent in the USGS Organic Act where the statutory language is all about ES.
- USGS's mission directly includes ES and their understanding. It is about providing information, not just the science, for decision-makers.



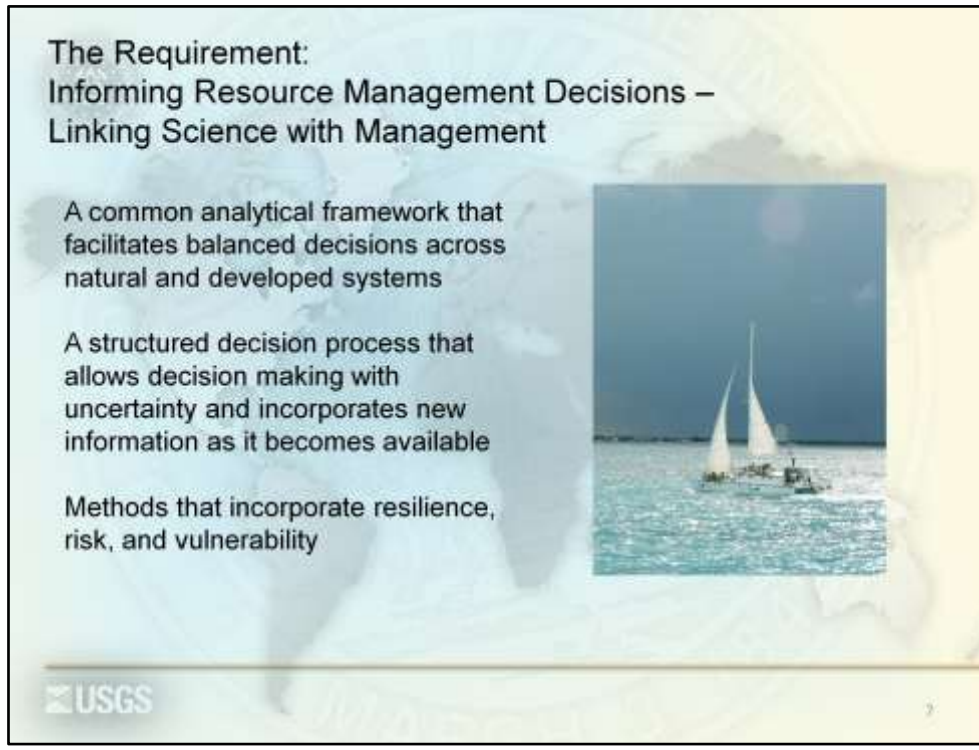
- In 2001, the National Research Council (NRC) did a study of USGS and recommended that USGS shift from a passive research role to one that is more actively producing science for decision-making.
- Again, in the context of this morning's discussion, the NRC was saying that USGS needed to shift its focus to inform decisions with ES. We need to move away from just doing science for science's sake and shift to doing science to inform resource decision-making. Essentially, we need to make science more useful for decision-makers.



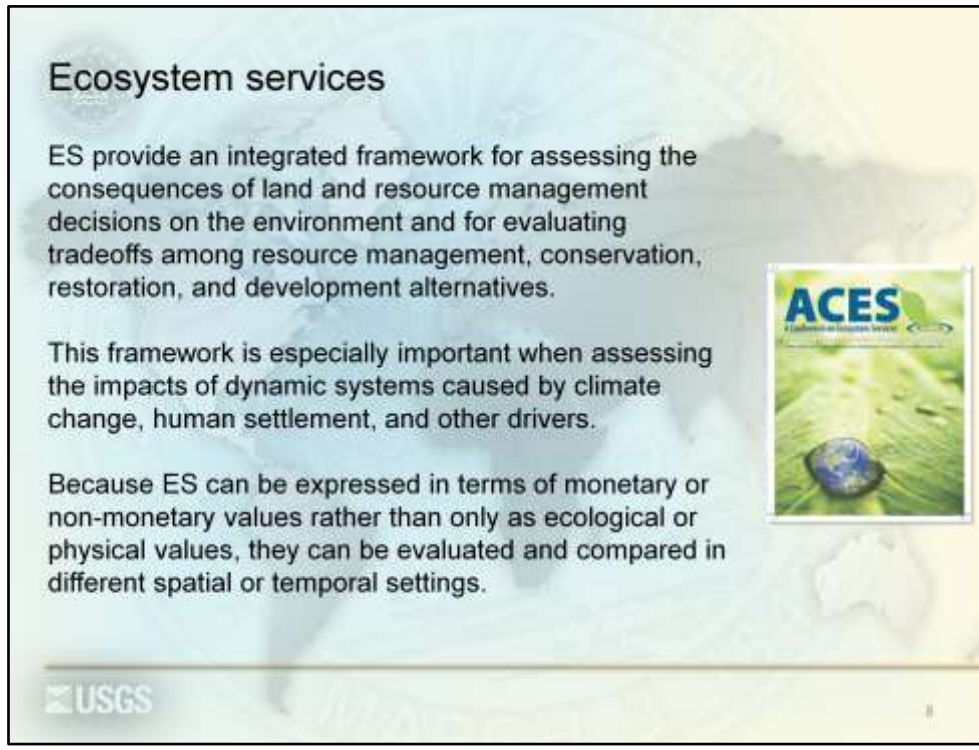
- After World War II, science was dictated from the supply side. It was driven by the notion that we need to do good science, translate it, and then use that translated science for decision-making. This worked well for the time.
- As the 20th century ended, science moved to the demand side. In this model, the demand comes from stakeholders. Stakeholders define the relevant issues and the science is provided for the related decision-making.
- This short discussion about the historical context helps to set the stage about where we are heading today in talking about ES.



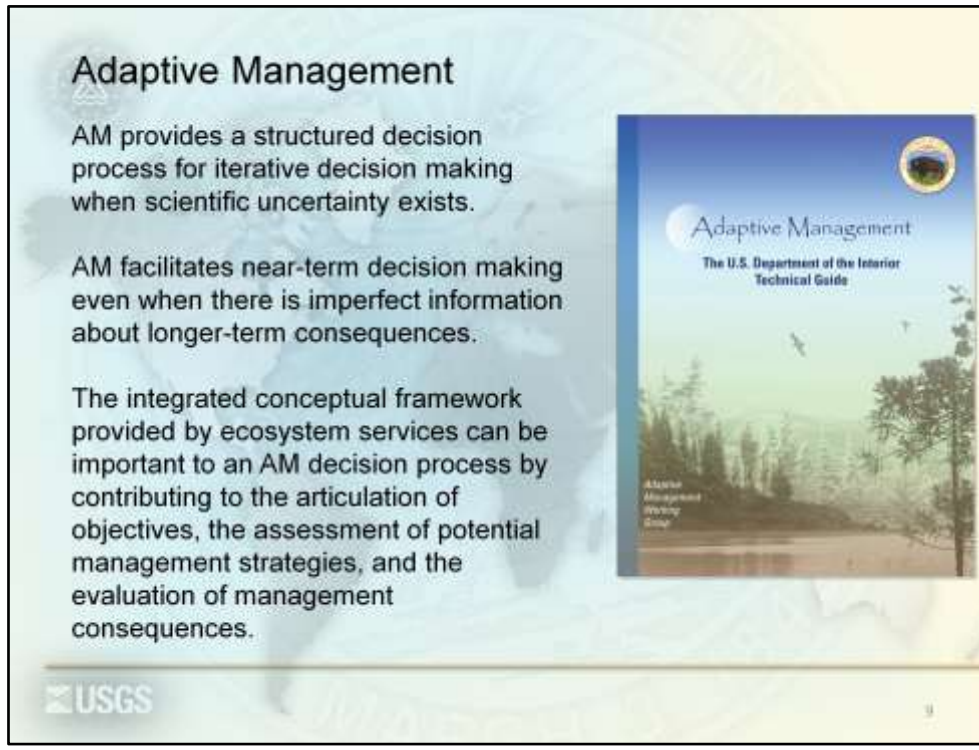
- Today, we are looking for synthesis. Science becomes more important and relevant for decision-makers once it is distilled and synthesized.
  - How do we combine information so it can share more disparate data?
- To get to this synthesis, it requires us to move along the curve to make information more useful for decision-makers.



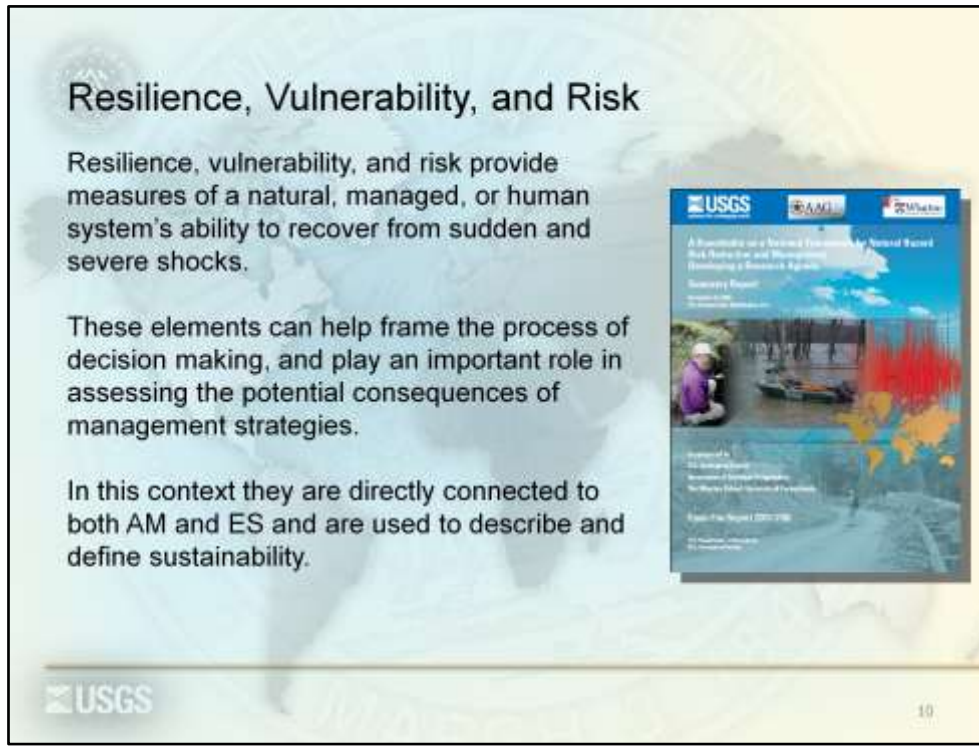
- There are several things that we have to consider.
- First, we need to establish a common analytical framework. When we have this, we will be able to look at both natural systems and the values and assets we already have. We need to connect ES with terms like gross domestic product (GDP).
- Our GDP is something like $14 trillion and the idea of ES and our natural environments has a tough time competing with such a powerful number.
- To some extent, our challenge is to establish a common analytical framework across these sectors. We need to express the values of ES produced in similar terms so we can discuss them and communicate across areas.
- Secondly, we need to acknowledge our uncertainty and develop a structured decision-making process.
- A structured decision process will help us make decisions knowing that things will change and allow us to incorporate new information as it becomes available. We still have a lot of unknowns and high uncertainty; management needs to incorporate these possibilities.
- Finally, we need to consider terms like risk, vulnerability, resilience, and identify what it takes for systems to recover from shocks.



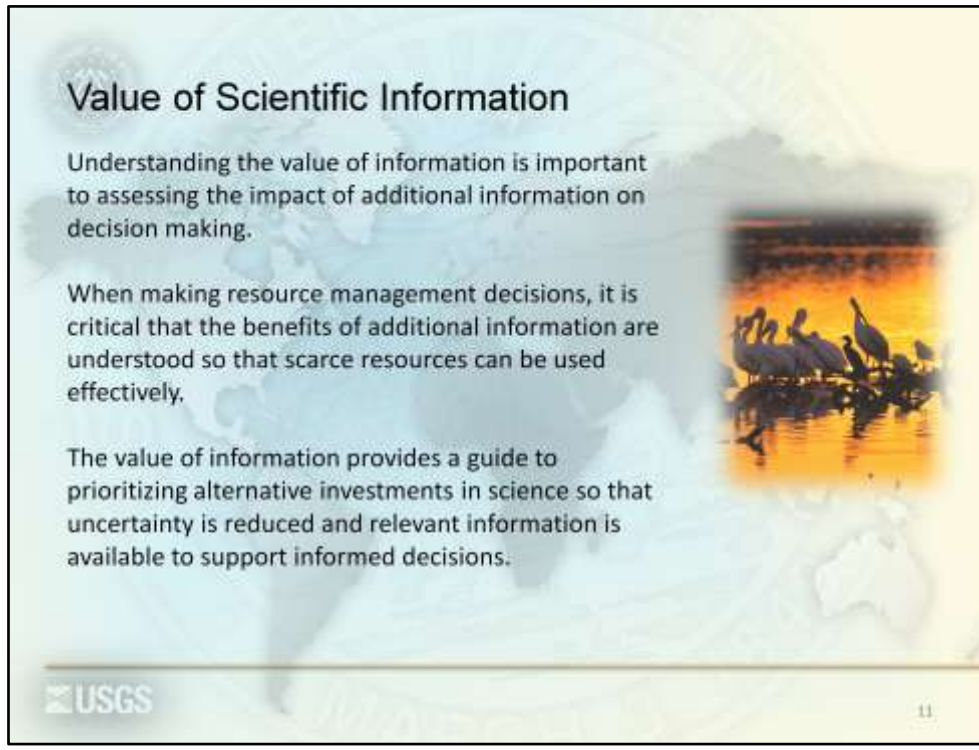
- ES provides us with that common analytical framework that we need. It is a mechanism by which we can make cross-sectoral comparisons. We can compare the value of ecosystems with things that have value in the developed world. ES functions have values that are commensurate with values in the developed world (GDP or some component of it).
- We are talking about the idea of measuring changes in ES.
    - What happens if we extract a resource?
    - What are the implications if we change the ES?
- There may be economic benefits or there may be economic losses. This is the kind of information that is critical for decision-makers.
- At last year's A Community on Ecosystem Services (ACES) conference, people discussed the dangers of not applying values to services. If we do not attempt to put values on ES, the value will be zero by default. This is a further argument that we need to find a way to value ES.



- Adaptive management is another critical part of the framework. ES need to be incorporated into this because uncertainty is high and we need a system that allows us to use new information as it becomes available.
- This needs to be a integral part of all decisions that use ES.



- We need to understand and develop metrics that allow us to measure resilience.
  - What are some of the factors that help us enhance resilience?
  - What can we do from a federal and nonfederal perspective to enhance resilience?
  - How can we restore our ability to have the provisions of ES?



- Another important issue to discuss relates to scientific information, which is an important part of this.
- We need more information, but at the same time, we have scarce resources and small budgets. We need to prioritize the use of scientific information to inform the decisions that we have to make.
- All too often, we do not think about this prioritization. We have to make them on an informed and uninformed bases. We need more information and more insight in order for us to make better decisions.

- Where are we now?

- USGS is measuring services and has made significant progress in the areas described on the slide. I will discuss a couple of them in more detail.
- Assessing ES flows
  - The major challenge here is the disconnect between the production and the location of the beneficiaries. Bees are a classic example of this. We are doing a lot of work, but we have more to do.
- Valuing services
  - Another big issue is how we value these service. Benefit transfer is less intensive but we do not know how effective it is or if it can be replicated. It is expensive and time consuming to recreate the process at each location, so finding a repeatable method is important.
  - We need to have metrics that are relevant for decision-makers. The decision-makers need to be convinced that the data is comprehensive and useful to them.
  - Our measure of success should not be whether or not something gets published in a journal, but rather if it gets utilized by decision-makers.

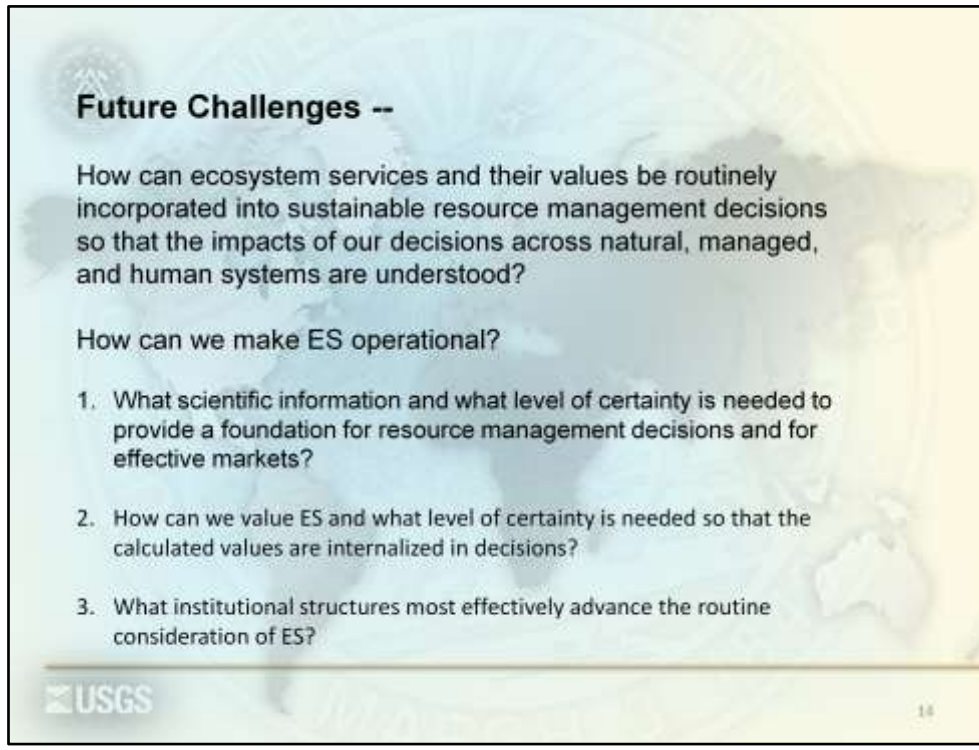
    - How can we do this in a way that convinces people that the data they have meets their needs and has enough level of certainty?

- Decision support tools
  - USGS is working on an ES portfolio model where we combine human well-being and valuation models. Again, the challenge is not just in developing these models, but

developing them in a way so that decision-makers use them. This is not to

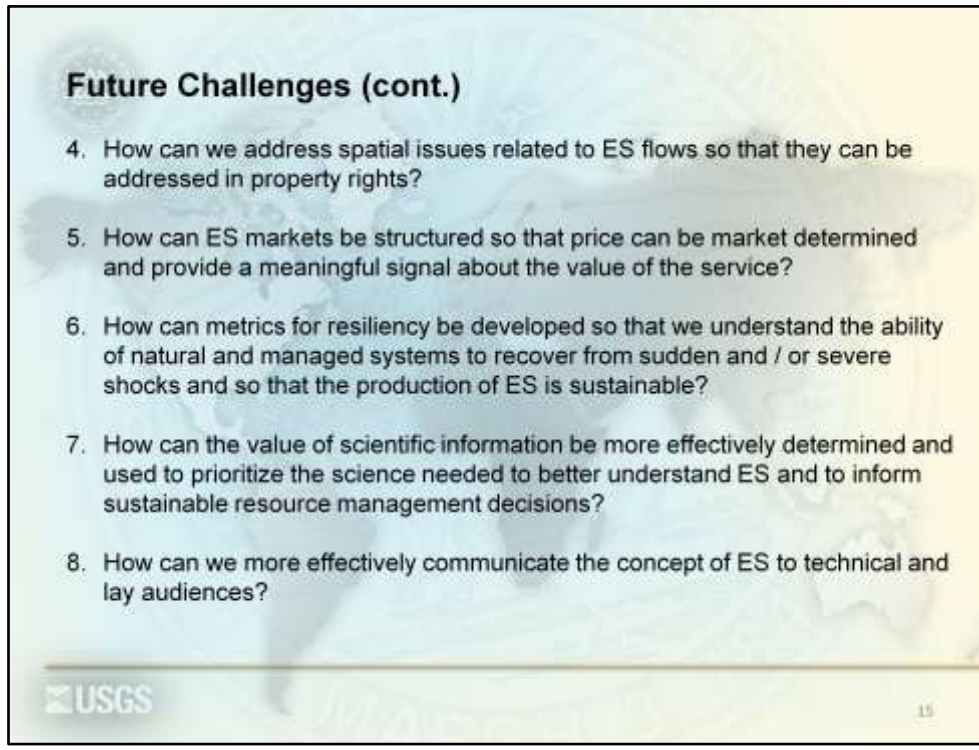
discount excellent work being done now, but it sets a target. We need scholarly work, but the end result has to be operational ES.

- Institutional assessment and structures
    - We have been experimenting with a lot of different structures, all of which are excellent, but we need to think about what structures will facilitate the use of ES. That is our target.

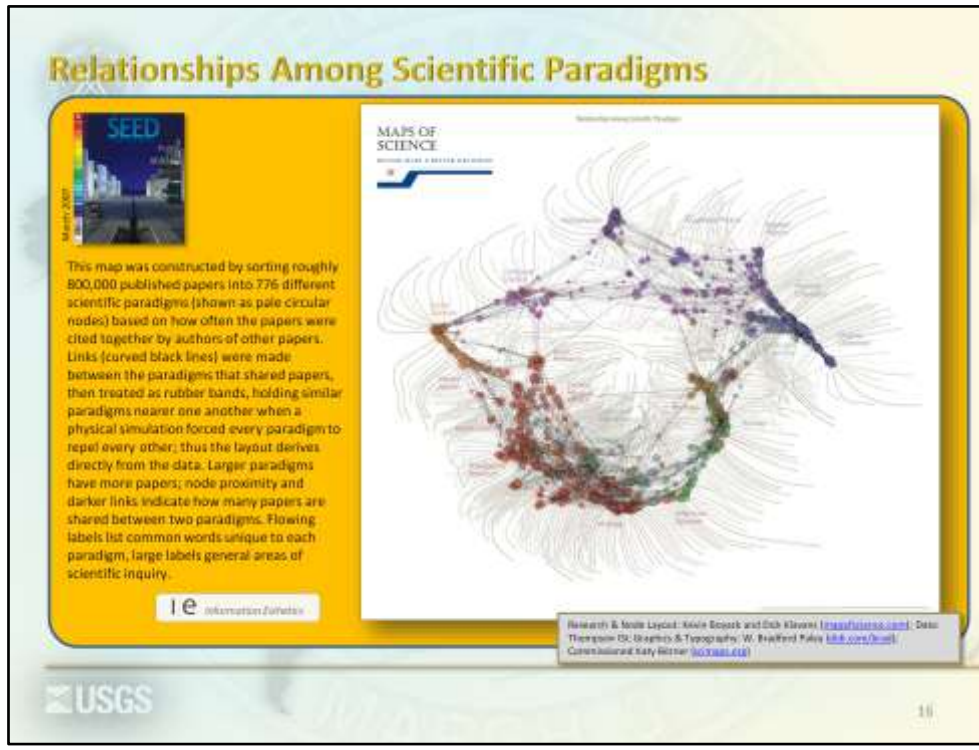


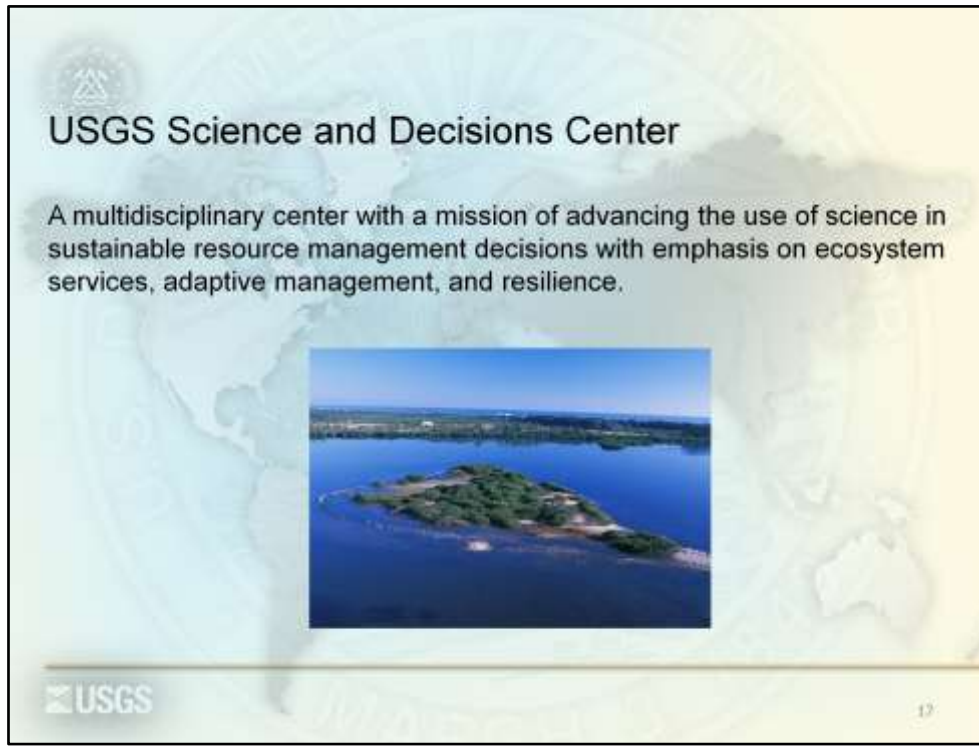
- What are the challenges that we face?

- Again, the overall question is about making ES operational. The slides list certain questions that are likely to pose challenges in the future.



- One key challenge we face lies in the establishment of property rights that facilitate effective and routine considerations. Lawyers have a key part in this world; it is not just about ecologists. There are fiscal scientists and many other professionals; the community is broad.
- Another challenge we face with payment for ES (PES), is that we have public funds paying for restoration when those responsible should cover the costs. Furthermore, in many cases we are paying for them without market information and independent of the actual price.
    - How can we better use markets to not only provide a mechanism, but also to provide information on how to pay for them?
- Finally, we need to figure out how to explain this broadly and not just to people in the conservation community. To be successful, we need to reach out beyond the conservation community and include mainstream people.


Relationships Among Scientific Paradigms
SEED
This map was constructed by sorting roughly 800,000 published papers into 776 different scientific paradigms (shown as pale circular nodes) based on how often the papers were cited together by authors of other papers. Links (curved black lines) were made between the paradigms that shared papers, then treated as rubber bands, holding similar paradigms nearer one another when a physical simulation forced every paradigm to repel every other; thus the layout derives directly from the data. Larger paradigms have more papers; node proximity and darker links indicate how many papers are shared between two paradigms. Flowing labels list common words unique to each paradigm, large labels general areas of scientific inquiry.
MAPS OF SCIENCE
USGS



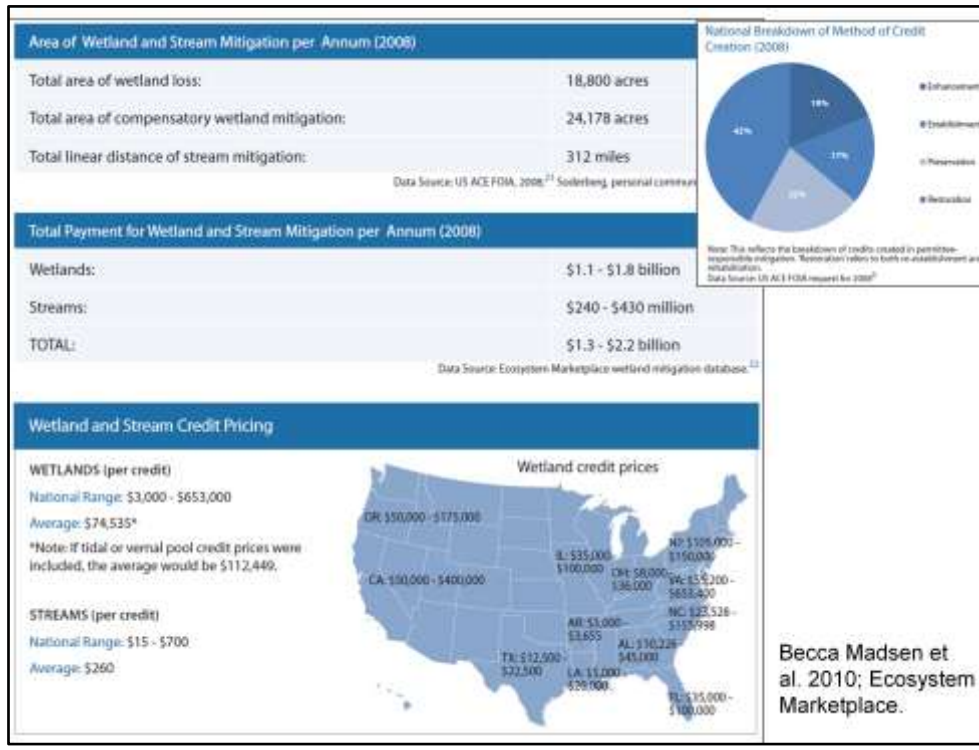
- As I close today, I want to leave you some information about the USGS Science and Decision Center.

Dr. Lydia Olander

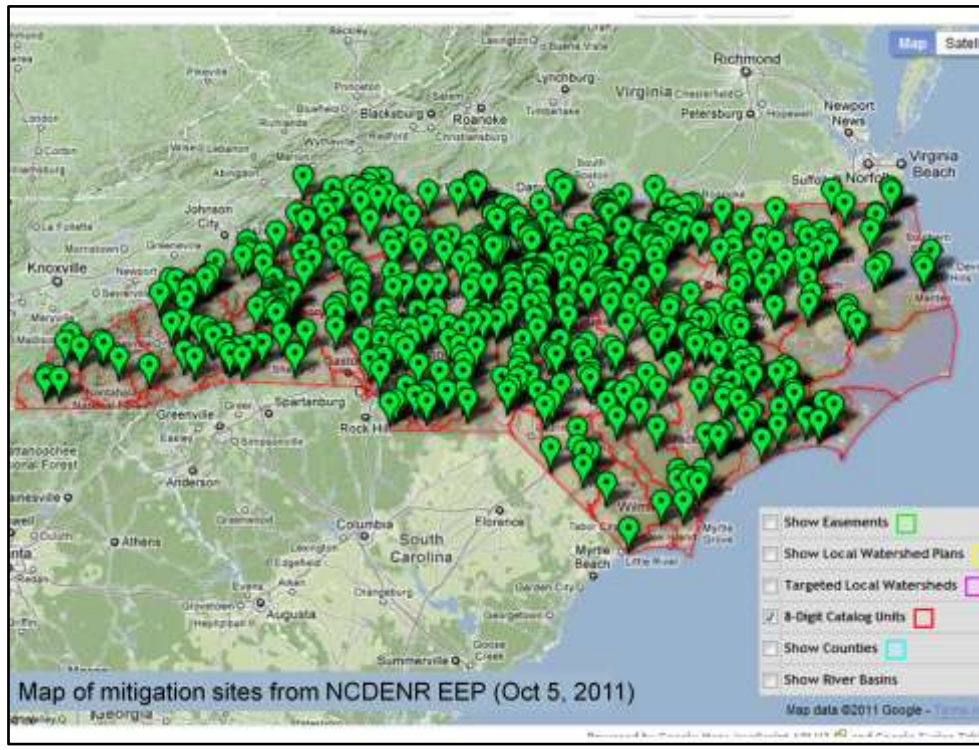
- Before we begin, I would like to acknowledge Bill Holman, Martin Doyle, and Emily Bernhardt who have all been instrumental and who's work is very relevant to today's discussion.
- The three of them are people who have helped to get me and other faculty members at Duke University to think about ecosystem services (ES) and its related topics.
- I have worked a lot with greenhouse gas policy and with Reducing Emissions from Deforestation and Forest Degradation (REDD) so some may be surprised to see me doing wetland work. At Duke, there is lots of interesting work related to water and in North Carolina , there are many mitigation programs.
- As some context, there are a number of ways ES can be incorporated into the public policy tool box.
- The regulatory guidance and mitigation mantra used for projects is to: avoid, minimize, and mitigate. Policies can do the same.
    - Integration of ES values into decision-making will work to avoid damages (and perhaps enhance services).
    - Payments for Ecosystem Services (PES) is an incentive based approaches used to avoid and/or mitigate damages.
    - Market/regulatory-based approaches, which address externalities, work to pay for damages and have mitigating or offsetting effects.
- The take home here is that we need all of these policies; regulatory mitigation should be our last defense not our only.

- One reason I thought this slide was interesting is because it shows the ways our watersheds have changed over time and it provides some context for compensatory mitigation.
- The Clean Water Act (CWA) is the oldest and largest mitigation program.
- Wetland regulation in the United States is rooted in the U.S. Federal Water Pollution Control Act of 1972 and the Clean Water Act of 1977, which provides for the protection of "waters of the U.S." under the Interstate Commerce Clause of the U.S. Constitution. Congress designated the Army Corps of Engineers (Corps) to administer Section 404 for waters of the U.S. with oversight from the U.S. Environmental Protection Agency (EPA). Through judicial interpretation "waters of the United States" includes wetlands. As part of the 404 program, the permittee must mitigate wetland damage, a process through which they (a) avoid all possible impacts, (b) minimize unavoidable impacts, and (c) provide compensatory mitigation of unavoidable impacts, i.e., create, restore, or preserve wetlands such that there is no net loss of cumulative wetland ecosystem function.
- In the early years of this regulation (until the mid-1990s), compensatory mitigation was usually performed on-site by the permittee (also often called the 'developer' or 'impactor'), resulting in the creation or restoration of numerous, small mitigation sites with limited ecological value in comparison to existing reference, less disturbed wetlands. During this period, regulations also began promoting off-site compensatory mitigation by permittees.
- Although this was thought to promote better mitigation, the ecological values of these compensation sites were also often extremely low, and the permittee, often a private land developer or a state department of transportation, did not want to be in the business of ecological restoration.

- In response to slow Section 404 permitting and high permittee-responsible mitigation costs throughout the early-1990s, entrepreneurs and regulators proposed creating large, consolidated areas of constructed wetlands, known as 'mitigation banks,' as pre-impact or advance mitigation. In order for a mitigation bank to be created, and credits from that bank sold, the mitigation banker must have the site approved by a Interagency Review Team (IRT) which is made up of personnel from the Corps, EPA, and other local or federal natural resource agencies (e.g., U.S. National Marine Fisheries Service, U.S. Fish and Wildlife Service, and state departments of environmental conservation).
- A key requirement of mitigation banking is that wetlands should be restored in advance of impacts. In less-developed regions of the US, however, mitigation bankers are unlikely to speculatively invest in banks because it is doubtful that there will eventually be sufficient demand for the created credits. Such markets are known as 'thin' markets. This lack of economic incentive to invest in mitigation banks has a feedback to development activities, as development activities become hindered or slowed by the lack of available mitigation banks in a region since developers cannot easily obtain a 404 permit. Such lack of available advance credits created the impetus for in-lieu fee (ILF) programs.
- ILF programs are run by government or non-profit entities that collect fees from developers (in-lieu of actual compensation) and then consolidate these fees over time to build the necessary capital to restore wetlands. Similar to mitigation banks, the obligation and associated liability for providing compensatory mitigation under ILF programs is transferred from the developer to the third-party mitigator.
- To summarize, compensatory mitigation of wetlands can now take place through three mechanisms:
    - permittee-responsible mitigation;
    - purchase of credits from a mitigation bank; or
    - purchase of credits through an in-lieu fee program.
- There are 38 Army Corps of Engineers and they all have differences in the way they apply the rules.
- Streams and rivers used to be mitigated with out of kind restoration (i.e. wetland or another different ecosystem type), but now we are starting to see stream mitigation. It has grown so much that it is starting to surpass wetlands.



- This is from Ecosystem Marketplace. It gives you the sense of the drivers, which provides scale, mechanism to transfer liability to make it work for developers and creates value through private engagement and investment.
- In a lot of ways the policy is working in this space.
- Just because the program is working at a large scale, does not mean that we have achieved outcomes we had hoped to.

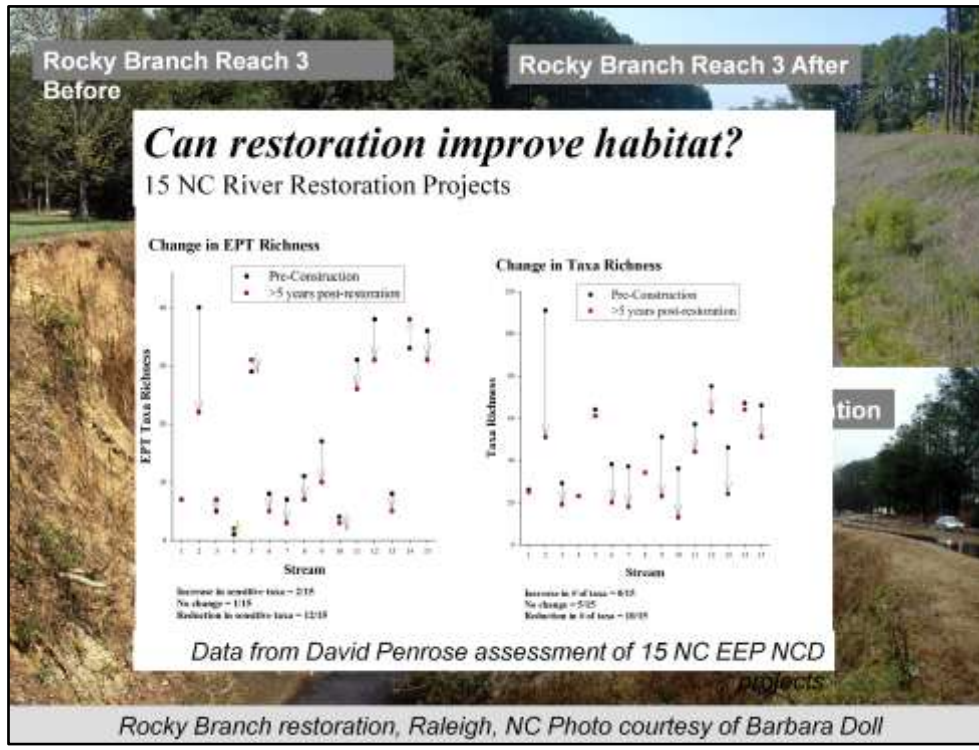


- This is a map of North Carolina Ecosystem Enhancement Program (EEP) and its mitigation sites.
- In 2003, the Department of Transportation (DOT) and the Corps teamed up to mitigate road building activities; the in lieu fee program became the main pathway for mitigation.
- EEP program has a few other pathway such as, nutrient offsets and buffers. Initially it was for DOT but now private developers can use it as well.
- With rapid suburbanization, there are 560 projects statewide.
- Zero DOT projects were delayed because of lack of mitigation, which helped move forward about $6.5 billion in transportation projects.

- In North Carolina, there is a lot of agriculture. Wetlands were cleared to make room for agriculture and now we are converting it back.
- In 2005 and 2007, EEP was ranked as a top 50 innovative government programs by Harvard University's Kennedy School of Government and won a prestigious award in 2005 from the National Association of Environmental Professionals.
- Instead of putting DOT in charge of restoration, an environmental organization conducted restoration activities, which increased restoration quality.
- It was a way to gain more strategic planning on how to set up mitigation opportunities and where to place banks.
- It allows for economies of scale so you could aggregate and address thin markets problem.

- "State records show that more than 30 stream restoration projects totaling more than $30 million have failed over the past decade. That represents more than 30 percent of the stream restorations the state has completed in that time" (News & Observer SUN, APR 17, 2011).
- In several cases, improper design or construction flaws contributed to the failures, but the businesses that made those mistakes rarely ate the repair costs. None were barred from future work.
- There have been a lot of problems and I will go through some of those related to policy:
    - Stacking incidents, where they pay twice. This happens often and only rarely gets press. They sold wetland mitigation as nutrient offsets and effectively sold it outcome twice. There is an internal demand for quantity instead of quality. Now, rules exist to help to avoid this issue.
    - In lieu fee program, allows development to proceed without mitigation. It take 5-7 years for any mitigation to happen and is opposite of banks. In lieu fee is set too low and reduces money available for monitoring. In North Carolina, the price was set by legislature; it was too low and it is changing now.
    - North Carolina has a relatively small service area, which has pluses and minuses. Recent legislation prioritizes mitigation banking and requires the banks to be in place before impacts are incurred.
- We have learned a great deal about policy design:
    - We know that we need transparency and now there is a database where you can see where the work is happening.
    - Timing matters.

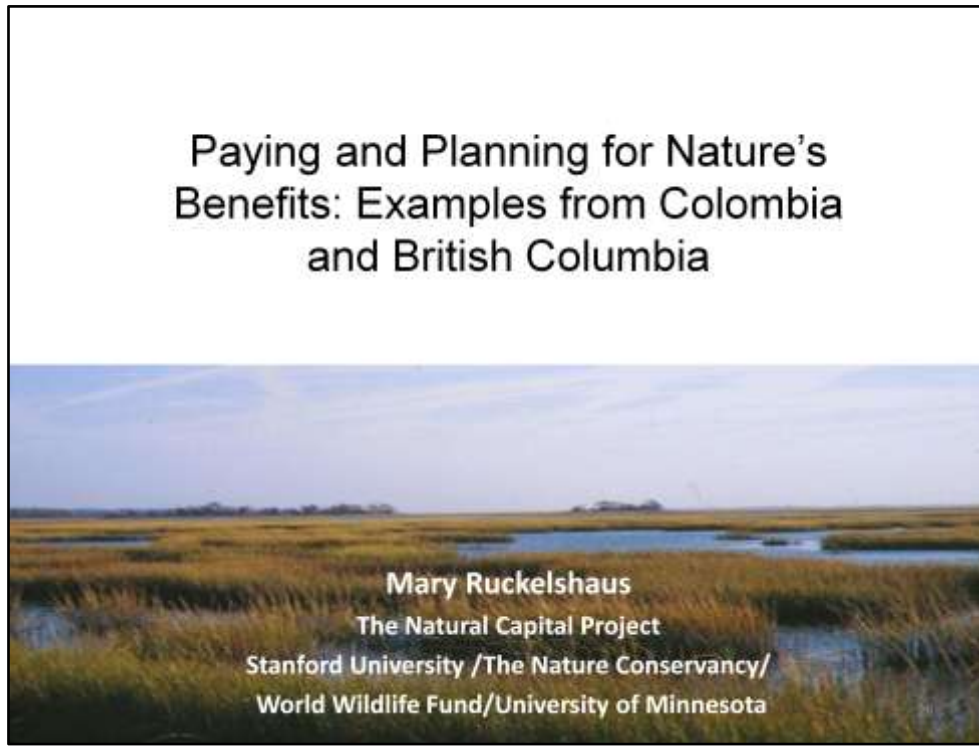
- Knowing the true cost is important so we do not use public funds and philanthropy to fund development. Developers should pay based on the true costs of their activities.
- Mitigation banks are good for economies of scale that are further away from urban areas.
- In lieu fees are good for small projects.
- There may be multiple different tools in our toolbox.



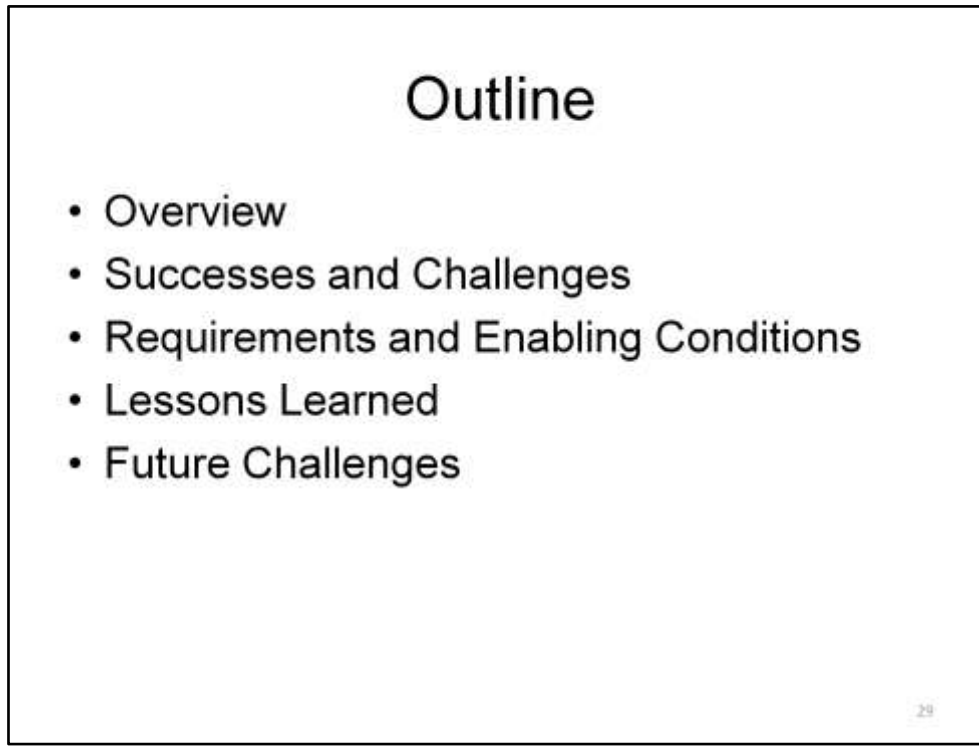
Rocky Branch restoration, Raleigh, NC Photo courtesy of Barbara Doll

- This is a restoration site in Raleigh, North Carolina.
- We learned about ES outcomes and other questions that we need to answer.
    - What is performance and how can it be measured in these sites?
- Acreage is not good enough. The researchers I mentioned earlier are thinking about this question and how it relates to ecological uplift.
    - What type of mitigation where provides which services? Where about size? How does form relate to function?
    - Is restoration working? If not, how do we make it work?
    - Martin Doyle is trying to understand how form relates to function, which can be used to better advise site selection.
- With stream restoration, we are finding problems with mitigation. We have a variety of different measurements at 15 restoration projects, five of which are post-construction.
- At these sites, we looked at insect diversity and found declines in species richness. We realized the species richness decreased because stream temperature increased from loss of side bank vegetation, which provides shade and reduced erosion. These are clay bank streams and so there is a lot of erosion and storm damage. Nearly 30% of stream restoration sites are having problems.

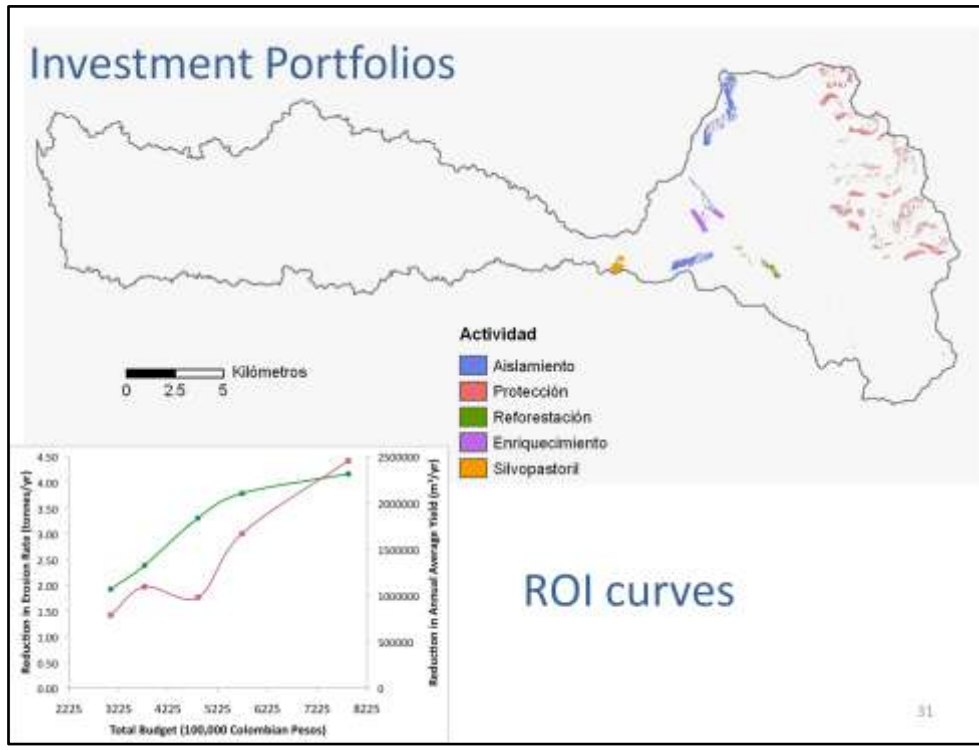
- The slide lists some targets for us to achieve by advancing ecological science in the future.
- We are having problems with replacement; it is not always working, but should be our last line of defense. Keeping development prices high may be a way to reduce harm and increase avoidance.
- "Ecological restoration is an activity that ideally results in the return of an ecosystem to an undisturbed state. Ecosystem services are the benefits humans derive from ecosystems. The two have been joined to support growing environmental markets with the goal of creating restoration-based credits that can be bought and sold. However, the allure of these markets may be overshadowing shortcomings in the science and practice of ecological restoration. Before making risky investments, we must understand why and when restoration efforts fall short of recovering the full suite of ecosystem services, what can be done to improve restoration success, and why direct measurement of the biophysical processes that support ecosystem services is the only way to guarantee the future success of these markets. Without new science and an oversight framework to protect the ecosystem service assets on which people depend, markets could actually accelerate environmental degradation." From Margaret Palmer and Solange Filoso (Science Perspective July 2009).
- My concern is if we have issues at a large scale, we will lose public support.
- The Nicholas Institute for Environmental Policy Solutions is trying to find ways to improve the system we currently have.
- There are other areas where lessons can be transferred like with water quality trading, storm water trading among different municipalities.
- There are policy implementation and science questions in all of these.



- There are two very different entry points for ecosystem services (ES). The Natural Capital Project (Nat. Cap.) has been working in the decision context.
- Nat. Cap. has been trying to demonstrate how this information can make decisions and how we can learn from it.
- I will talk about two specific projects today. The first in set in Colombia and is a payment scheme for a water fund investment. The second is in British Colombia and involves marine spatial planning (MSP).


Outline
• Overview
• Successes and Challenges
• Requirements and Enabling Conditions
• Lessons Learned
• Future Challenges
29

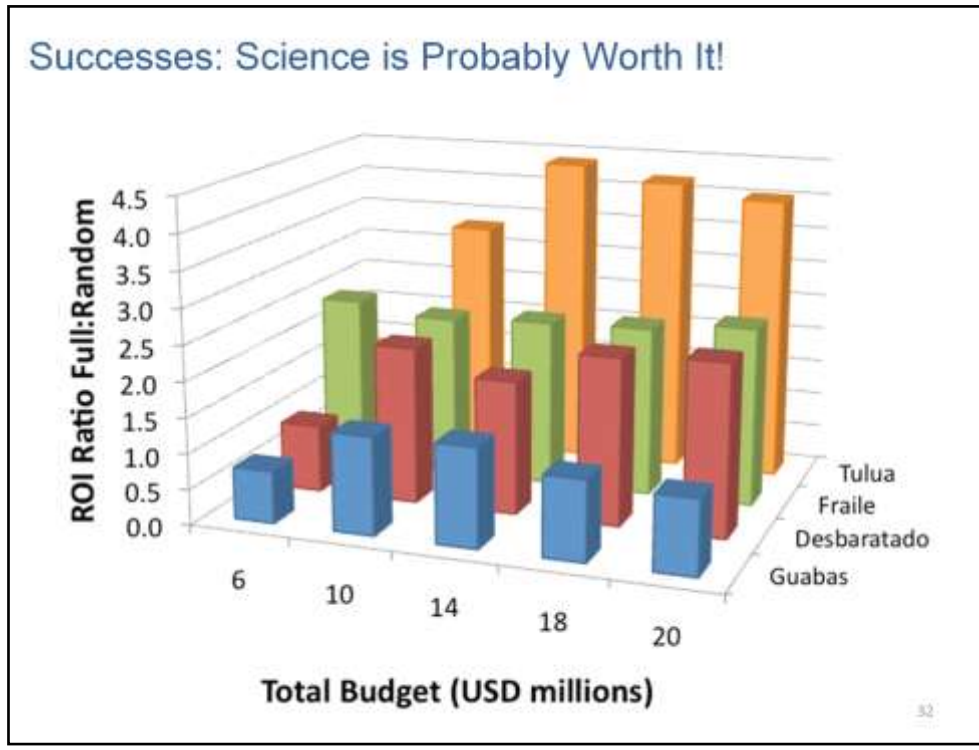
- This first project is led by Heather Tallis.
- It was initiated from the Delaware Catskills example and some other older water funds from the early 90s.
- The idea has been around but it is starting to accelerate now.
- This is a set of 11 watershed that feed into Cauca Valley. It involves cities, public utilities, sugar cane companies, bottled water companies, and citizens; it is a relatively mature group of people. They asked the Nat. Cap. to offer advice on how to improve their existing fund. The slide lists the main questions of the fund.
- The fund was a voluntary fund manages by a steering committee. They wanted to invest the fund's interest (USD$10 million) over three years to affect upstream practices to help downstream users.
- Our advice was to fund fencing activities, pesticide reduction, changes in grazing practices, and increased control to limit illegal cutting of trees.



- We have an accounting tool the we use to visualize these things.
- One of the first is to build return on investment (ROI) curves. In the graph above, we compare the money invested against two services: erosion is on the left and in green while reduction in water yield in the stream is on the right and in red.
- They look at these curves in the catchments to get a ball park of how much they need to invest by considering tradeoffs. For instance, more vegetation means less water will be available in the streams.
- Also, this tool can help them look at space.

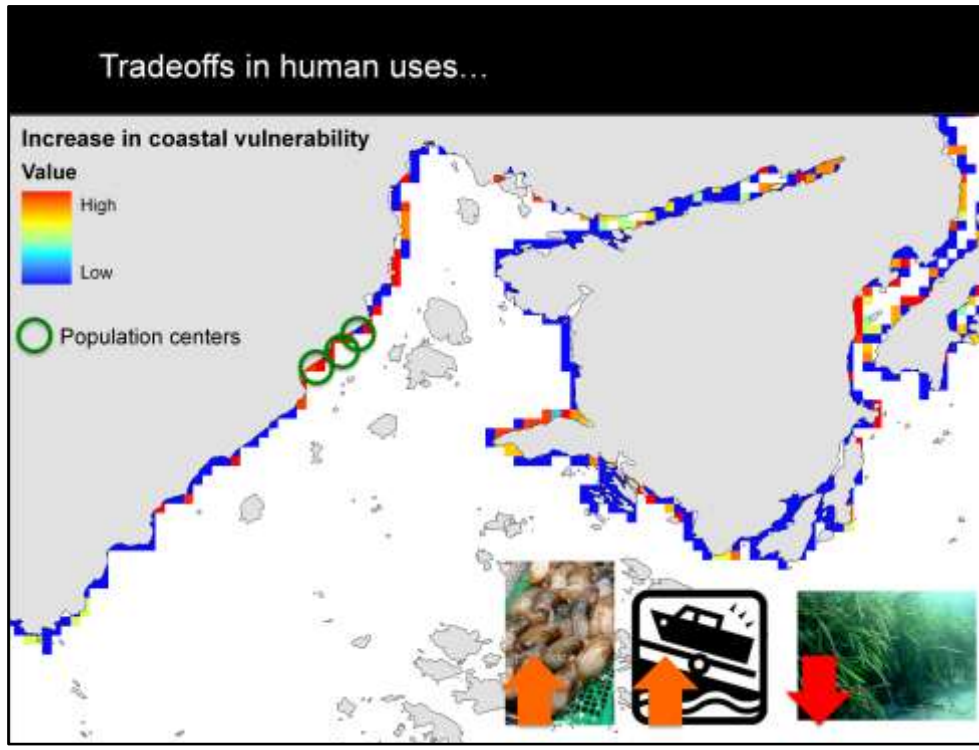
    - Where should we use different activities?

- There are various activities that can be used. In this case, we have shown where one might array the activities; not just the total amount, but their spatial distribution as well. This is the kind of information we provide and they use it to guide investment.



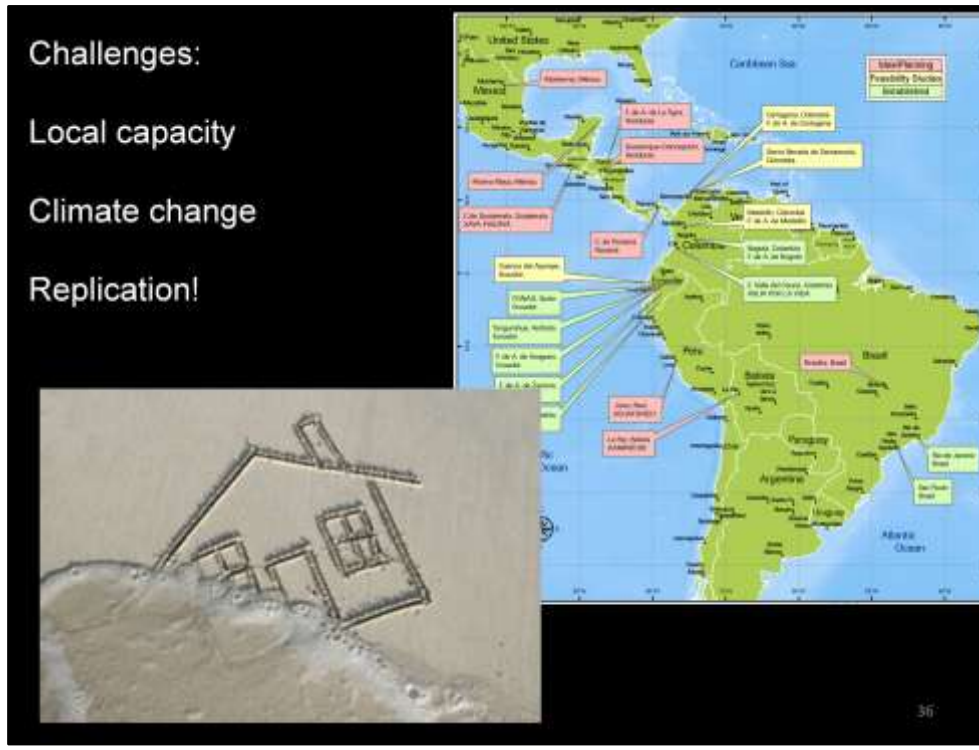
- This shows the ratio of ROI between the targeted and random approaches for each budget level in each watershed.
- This shows four out of 11 total catchments.
- We determined the ROI from using guidance for the accounting tool vs. ad hoc decisions.
- When ROI >1, it indicates a real bounce in improvement. You really can get up to a four fold investment return.
- For example, in Guabas, the approaches had about the same ROI (ratio is 1);
- In Fraile, the targeted approach gave twice the ROI.
- In Tulua, the targeted approach gave an ROI that was four times better.
- I will come back to this at the end of the talk to mention challenges and lessons learned.
- This is one context where there is an active and engaged group.
- We have shown through our engagement that if you have specific information about where services are provided and flowing, you can get and improvement.

- We are working in two places to help make the big idea of MSP a reality.
- The first area is along the west coast of Vancouver Island, Canada. There we are working with WCA, a public-private partnership with four levels of government, industry, and NGO participation. In this example, First Nations are key; their treaty and settlement lands stitched together make up the lion's share of the planning area.
- This is another very different context from the Colombian water fund example; this is a MSP effort. It is very young and totally bottom up. It is driven by an NGO, a couple of mayors, First Nations, citizens, and private industry (aquaculture and logging). The biggest revenue generating industry is tourism, of which, surfing is the biggest.
- The groups have come together in a voluntary way and are organized to achieve the following goals:
    - Minimize conflicts between users.
    - Provide them with the benefits they want.
- We entered into this right when the NGO and public-private group was starting to develop its vision and values; we entered much earlier in this example than we did in the previous example.



- This map shows the InVEST results from a scenario where we increased shellfish harvest and increased boat traffic. These two negatively impact eelgrass, which in turn loses the capacity to protect the shoreline from erosion and flooding during big storms.
- We have been able to show the group different scenarios (based on their vision and values). We want them to tell us how they want to use their space and what is important.
- They did lots of community outreach to get together and find common objectives. They went to tiny towns and villages to define objectives.
- We mapped them as scenarios. One of which is that they want to boost commercial value of ocean extraction (i.e., aquaculture, to which the First Nation has management rights) and tourism (i.e., lodging, boat ramps, etc.).
- The slide depicts the map of the enhanced tourism and increased aquaculture scenario. The result of increased development (aquaculture and tourism) impacts nearshore wetlands and sea grass habitats, which is another tradeoff because these areas are important for young fish species. Recreational and commercial fishers may be upset about this. The areas also provide protection from erosion and storms.
- The red areas show increased vulnerability because of negative impacts to buffering habitats. We can also show where the people are going to be most affected.
- In response, the community is looking to relocate some activities to increase vegetation. They are moving activities across the bay to reduce vulnerability to private property while still sustaining aquaculture production.
- This is one way the tool helps people plan out how to use their area to maximize and obtain most goals.

- In both cases, there is a lot of local ownership because people have been involved from the beginning and helped to set objectives.
- In Colombia, they invest annually and look and ask landowners to voluntarily come forward and ask for funding to improve practices based on the map we devised. They are starting to implement this and have invested $500K so far.
- In the British Colombia example, we brought very disparate groups (native and commercial fishermen, tourism, etc.) together to talk to one another and map out a unified vision. They have a much better shared understanding of what they have and how it might be changed. They are using our maps and alternative futures to advise the MSP process.



- I agree with Carl and Lydia's lists about future challenges; we can make long lists of challenges.
- I think we do need to focus on the question of how to incorporate ES information into practice.
- Local capacity can be bolstered with some basic accounting tools and maps to show where benefits are distributed and how they will change in the future. In some cases this exists, in some it does not.
- We need to focus on making processes replicable. We do not want to take two years to work out a meek ROI; it is much too slow of a pace. The Nature Conservancy has a goal to establish 34 new water funds in Central and Latin America. This is very aggressive and exciting, but in order to do it, you need to make this process simple. There is value in generalizing this process. Figure out what metrics are needed for the decision instead of what we have the ability to calculate.
- The same thing is true for climate change. We can make models for this and we just need to simplify it and make it replicable.
- Finally, the guidance around ES are all principle-based or modeled. Lydia showed examples where people are actually measuring things. Did you see the benefits? That is virtually never done. There is a big challenge to get people to monitor. The water funds are mostly business people who want to see how their investment has an impact; they are providing money for monitoring.

- I want to leave you with this one idea today. It is about the metrics.
- What everyone wants to know are what the metrics are.
    - Is it the dollar value?
- In many cases people do not want the dollar value, they just want to say "No, that area is off limits."
- Everybody wants metrics that relate to livelihoods.
- In the US, it is about job numbers, in other places it is about how many people can rely on the system.
- These are very hard to link to ES.
- Economic disciplines do not typically talk to one another. Working on the methodology is challenging, but we need to continue to do it.
- They all want livelihoods.

Audience Questions

- Participant
    - We need provisions made for monitoring and feedback, but it does not happen because you do not learn anything. I liked your emphasis on replication. So much more can be done if you can take one experience and move part of it to the general base. I was so struck by the value of economics and your discussion of it.
- Participant
    - Is there anything on the horizon or are there areas you are working in that have opportunities to work with foreign policy?

Mary Ruckelshaus

- Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is essentially a United Nations (UN) body that has just been established. IPBES is essentially the Intergovernmental Panel on Climate Change (IPCC) from the Millennium Ecosystem Assessment (MEA). It is in its early days, but it is making progress. They are setting up to do the next round of ecosystem services assessments around the world. We need to think about how we are going to monitor and what those metrics will be.

Lydia Olander

- Corporate sustainability efforts have a lot of overlaps with ES and what it is trying to achieve.

Carl Shapiro

- One of the readings recommended for today's session, on domestic policy is very relevant to our domestic policy. Please see:
  - President's Council of Advisors on Science and Technology. Executive Office of the President. *Report to the President Sustaining Environmental Capital: Protecting Society and the Economy*. July 2011.

Participant

- I found that these case studies are very helpful because they are very different from one another. To recap from the last one back to the first, Mary talked about spatial linkages and interests, Lydia talked about temporal interests solving problems before and after development and the issues that arise later on, Carl started talking about responsiveness of stakeholders and the need to link to the momentum of large-scale interest, and finally, Heather talked about the importance of good governance, which to me, was a warning sign. Strong governance is what we do not have in most of the world. In places where it has been strong, it looks like it is weakening.

  - Where does ES offer the promise of strengthening governance and where does it not? What do we do in those place where ES does not offer the promise of strengthening governance?

Carl Shapiro

- Externalities are at the heart of the whole concept of ES; it gives us an opening to this whole issues of governance. In some cases, our property right structure does not give us an opening into governance. We need to focus on ways through governance instead of having additional studies relating to them.

  - How can we make them part of the routine processes? What government approaches can internalize this?

Participant

- The discussion of property rights is also very interesting. In REDD, you are trying to create new property rights. Creating and enforcing property rights is different from policy.

Lydia Olander

- REDD, and other processes like it, do have a role in transparency. In the US, the push is for performance-based approaches. The Farm Bill is an example where there is a lot of talk about transitioning from handouts to something that has a real impact. In both public and private property, there are ways to affect this.

Participant

- I was struck by the four times improvement by understanding where to target investment. Issue with the Farm Bill is that there are "random" scenarios; we are not looking at where we are investing money, which is really remarkable. I would like to learn more about how it happens and how it can be applied to other expenditures.

Mary Ruckelshaus

- One thing I liked about the difference of comparisons is that there are huge potential benefits if we can get there and provide the tools. Different places have different entry points where people can work and provide the necessary nudges. There are lots of places where we can work.

Seminar 6 Discussion Synthesis

October 6, 2011

This document is a synthesis of important topics and questions discussed during the question and answer and discussion period immediately following the panelists' presentations. Please keep in the mind that the following is only a recap and speaker identities have been removed, except for those of the panelists. We hope that the following notes and discussion questions will be used as resource to advance further discussions about ecosystem services.

Below you will find a summary to specific key questions and topics covered during the seminar discussion.

Question 1

In your experience, what has been the policy draw for the work you carried out and what metrics have been of interest? Supply, service, value metrics? How have you been able to or plan to insert this work into a decision-making context?

DR. RUCKELSHAUS

- I gave a few examples of this and what I am seeing in our 12 demonstration sites (and what we are trying to do with the Natural Capital project) is to bundle services and considerations for the decision-making context.
- In China, for example, where they have a strong central government, they have funding and planned management for the national and provincial levels. That is an example of a strong government mandate where we have been working in.
- In Vancouver, it is very bottom-up; community groups and mayors in the province got together and began initiative. Revenues and economy depend on environment and the political landscape is quite opposite of a strong central government.
- The Colombian water fund was spearheaded by private investors and as you can guess, the policy context dictates metrics. Return on Investment (ROI) curves are essential for this group. The y-axis was not dollars, which is unusual for ROI curves. The group was entirely satisfied with expressing the return in quality of clean water and level of stream flow as their indicators. It does not always have to be dollar to dollar, which is one important lesson we have learned. In fact, in Vancouver, they actively resist monetizing some of the ecosystem values. They do not want cultural and existence values to be monetized at all.

DR. SHAPIRO

- As we develop and think about metrics for ecosystem services, one thing that hits me is the need for ecosystem services to be broadly understood and accepted. The notion of ecosystem services cannot be an exclusive commodity for the conservation community. As we develop metrics, we need to think about this and simple efforts such as defining what services are and developing accepted methods for measuring them, whether in dollar or physical ecological terms. We need to be able to explain these ideas to people. This would go a long way to making ecosystem services operational.

PARTICIPANT

- Responsiveness and timing also jump into my mind because this affects significant land banks in California. The adaptiveness and responsiveness of metrics and this effort coupled with getting it into state policy and to decision-makers in a concrete way is important. There is an opportunity to build from a small framework; I am thinking in relation to the Williamson Act and correlated issues.

Question 2

Do you have a suggestion to increase adaptiveness and responsiveness?

PARTICIPANT

- I have been thinking about it. We are just thinking about it. At a statewide level, we have good leadership with our natural resources secretary, but we need the economic experts to help and commit the funding to look at this more seriously.

PARTICIPANT

- In terms of engagement, there is an area people forget to engage and that is the insurance agency. We need to talk about the National Association of Insurance Commissioners and the Office and Management and Budget; let's get them involved and get national economic advisors to focus on this. The insurance industry is watching this, but people forget to bring them in.

DR. SHAPIRO

- That is very interesting especially considering property rights and getting insurance involved.

PARTICIPANT

- Business loss is what gets insurance industry involved.

DR. OLANDER

- On my way to California, I stopped in Milwaukee for a conference of water leaders. The conference discussed the work that is needed on our water systems and gave a presentation on the new green jobs report. The report says that the new green jobs are in water. They presented some substantial numbers; they recognize our crumbling water infrastructure and the need to repair it. There will be money there and making it green by utilizing ecosystem services is another avenue.

PARTICIPANT

- In the work that we do with government, we want to see what nature's value is. Often, we encounter the dilemma of not having the data to show livelihood metrics. There is a universal interest in quality of life metrics; it is an omnipresent force, not just in U.S. The census could be a great tool; if we could convince the Census Bureau and Department of Statistics to collect data on relevant information, it would be huge. We need data over time; I think that is an interesting vehicle.

DR. SHAPIRO

- I think that this consistent with the idea that we need to find a way to account for services, which brings in concern about monetizing activities. Without a calculation or expressed value, it will be zero automatically. What I am struggling with is the forcing of dollar values when it may not have much use. Are there other values that have an importance? By finding some way of measuring the service, it will get us to a point where we answer these questions. Mary brought this up and I think it is very valuable and needs addressing.

DR. OLANDER

- I have been learning more about the corporate side and one thing we talk about are product categories, what if we had service categories and had a way we could track them?

DR. RUCKELSHAUS

- The World Bank is leading a group to define service categories. The point made about census data and methodologies gets at the crux of the issue. For instance, Tanzania has amazing census data and has a time series. Once those methodologies are better tested, it would be great to get a mechanism to collect data so that we can add questions to the census and ask more relevant questions.
- The problem I have with national system of accounts is that they do not know how they will use what they are collecting. You will have lots and many different metrics.

DR. OLANDER

- I wanted to note that a project at Duke that is trying to link census data in Indonesia.

MS. WRIGHT

- It is interesting that you bring up the collection of census data in developing countries because there is a discussion about adding questions to national level censuses to monitor the provisioning of Reducing Emissions for Deforestation and Forest Degradation (REDD) co-benefits, namely social and environmental safeguards.

PARTICIPANT

- In 2008, Businesses for Social Responsibility (BSR) talked about the need for ecosystem services ideas to be valuable by business, but the case studies continue to be rare. The New York City Catskills example is used a lot, Natural Capital is trying; we are doing a lot top down and trying to figure out what the mousetrap looks like. People at the county level have projects where they are working and a lot of insight into this. These are the people who need to deal with ecosystem services and we never hear that come out in the dialogue enough. If it were out there, I would love to hear about it.

DR. SHAPIRO

- Your mention of the Catskills example hit a nerve. One of the best examples we can used is one where a natural system can get the job done for less than human cost. That type of example has a lot of weight both in the U.S. and outside of the U.S.
- What I see as more complex and challenging is the issues of how we make resource management decisions. Again, I work in Department of the Interior, so what is important to me is how to determine what is the most effective use of our resources and land and how we compare tradeoffs.
- Our challenge is to find ways to address tradeoffs, particularly when there are strong interests and demands, which move in the way of economic development. The challenge is to find a way to develop metrics to measure service values and to communicate them to those who are not routinely thinking about this sort of thing.

PARTICIPANT

- We do not have a strong list of metrics. When you work in different sectors like forestry and aquaculture, there are all sorts of messy things. The people running those businesses say "tell me what you want," but we don't have a list of what we need. We do not put out the obvious so people can do the right thing. Some will do it if they know; others will work out payment schemes for ecosystem services (PES), while others will continue because of disincentives in the public system. The bottom line is that the obvious needs to be out there.

PARTICIPANT

- I would add that adopting approaches that are easily grafted to other approaches already in place would be helpful. We do not necessarily embrace dramatic new approaches. We are very incrementalist. Never forget that the systems are horribly flawed.

DR. SHAPIRO

- As an economist, economic indicators are used all the time (GDP, unemployment rate) and they are all flawed. They are results of imprecise data and when you look at them, you can find many flaws. Despite these flaws, they add value. We are not going to develop a perfect set of metrics, but can we develop a set that enhance our ability to make informed decisions.

Question 3

What characteristics have you seen in institutions (what is required of institutional capacity) where the ecosystem services approach has worked or is working to secure policy gains? Any specific institutional settings that work well for this type of approach?

DR. OLANDER

- One thing we talk about is how to improve the institutional setting. In North Carolina, there are a number of programs that can be combined. If we integrate different programs and coordinate them, we think we can create better outcomes and save money, which we all know is really important right now. One idea is to create an institutional way within the state to coordinate all of this.

DR. RUCKELSHAUS

- Another thing is about institutional capacity. There is tremendous learning that has to happen with all of these applications. The institutions will also need to have transparency; if there are monitoring activities, report it and make sure people see it. Often, monitoring capacity is lacking and data sharing and reporting are weak as well, but users want to see their returns.

DR. SHAPIRO

- One key point that comes to mind is that many ecosystem services have public good characteristics and there are questions of who has ownership rights. When we think about institutions, we think about incentives. How can incentives be created to address these things and provide a basis to do this. The topic of incentives and property rights go together.

Question 4

You mentioned a lot about what the United States Geological Survey (USGS) is doing in terms of incorporating ecosystem services into USGS, can you comment on interagency efforts that look at ecosystem services in an important way?

DR. SHAPIRO

- There has been a lot of activity. The United States Department of Agriculture (USDA) has the Office of Environmental Markets, which looks across federal government and elsewhere at how markets are used effectively. These are relatively small offices and small efforts. The Environmental Protection Agency (EPA) has an ecosystem services atlas, which Lydia may know a bit about, that looks at ways to identify spatial locations of ecosystem services. The Center for Environmental Quality (CEQ) was doing an inventory of ecosystem services study efforts across the U.S.
- There have been a lot of efforts, but I think there is a continuing challenge to develop a set of partnerships that brings all of these issues together in a clear direction of what is next to provide a broad set of recommendations. We have been looking case by case and making incremental changes. I am not sure we are where we need to be.

PARTICIPANT

- From our local work, I can see a big flaw. It is great that three federal agencies are working together. We run into issues while working with Fish and Wildlife and the Army Corps of Engineers (the Corps); it is hard to get them to think outside of the one species box and to think at the watershed level.

Question 5

How can agencies to start looking at level where instead of spending money just on the red-legged frog, they also work on water quality? How do we both from the state and fed level, take work that others are doing and make it work? How do you keep maximizing levels of dollars?

DR. SHAPIRO

- You cannot do that without first addressing institutional issues, which is a challenge in the U.S. How can we take concrete steps? USGS and the Bureau of Land Management (BLM) are working together; the effort is not to say what research we can do, but to determine how USGS can collectively work with BLM resource managers to better incorporate ecosystem services in decisions. This is addressing some institutional and cultural issues; it is taking science and linking it with management and addressing what has to happen for BLM resource managers to use and believe in ecosystem services as a helpful tool.

DR. OLANDER

- One reason we, in North Carolina, are interested is that we have a political opportunity at the state level to get them thinking out of the box. New leadership is asking questions about getting ecological uplift and is getting agencies involved that need to be involved. It will still take a while, but we wanted to take advantage of it.

PARTICIPANT

- I am thinking about how to integrate this from my experience with permits. There are lots of tools and metrics to measure performance, but there is a need to streamline protocols. A new protocol is created for each new local ecology. The same circumstances exist if you are trying to overlay carbon methodologies; it is incoherent. There is a leadership void and we need some fundamental principles, at least for the things we measure. We need to enable coherence for agencies to talk to one another; this is an area that needs work.

DR. OLANDER

- There is an effort in Willamette, Oregon that is trying to address this.

Question 6

We always want to know what communities are working on this and we always want to talk about business. Where is business in all of this? It strikes me is that we need a business council for ecosystem services that will walk into government and say they want to make this happen. Who are they? What business are you working with?

DR. RUCKELSHAUS

- In our case, we work with Dow Chemical Company (Dow).
- I see four categories where business is engaged. In this first example with Dow and The Nature Conservancy (TNC), the motivation is about Dow's bottom line and not about green branding. They are concerned about the water supply in Texas where there is a huge drought.
- Other category, where companies like Coca-Cola and Pepsi are involved in water funds, involves thinking about life cycle analysis. They want to determine where they are vulnerable and it also gets back to the bottom line.
- Another category involves business industry roundtables, i.e., for soy, palm oil, rice, cotton, beef, bottled water etc. Businesses have convened, some are young while some are mature, and they ask us to come and give presentations. Again, they are all thinking about their bottom lines and less about greening.
- Last thing, we have been asked twice to work with developers on both the opposing side and from developer's side. They ask us to build a sustainable development plan. Those requests are coming in, but it is not the bulk of demand.

PARTICIPANT

- In addition, I want to point out the utility sectors: oil and natural gas, energy – they all have transmission lines and all companies are very involved. Think about the BSR approach and the World Business Council for Sustainable Development (WBCSD) and U.S. Business Council. There is an opportunity to coordinate and catalyze efforts of all of the company efforts.

DR. RUCKELSHAUS

- BSR and WBCSD are very conceptual right now and are not grounded in anything so it is hard to engage business in this way.

DR. OLANDER

- In U.S. as well, agricultural commodity groups are doing life-cycle analysis and thinking about greenhouse gases and models.

PARTICIPANT

- We do see a difference in willingness to invest between Corporate Social Responsibility (CSR) communities and pre-compliance communities, which can be driving force in many ways. They are fundamentally completely different motivations but the buyers and actors are similar.

DR. SHAPIRO

- BSR recently commissioned a report on ecosystem services tools. They have been studying this and monitoring environment.

Question 7

Do you see financial services groups involved in this? What about banks?

DR. RUCKELSHAUS

- There is lots of discussion with development banks. They are all actively discussing it in their research and development arms, but I do not know about any actual applications of it.

PARTICIPANT

- Shell Oil has probably spent the most money, often from self-greening, but there is money being spent but how it is integrated into the bottom line is a question.

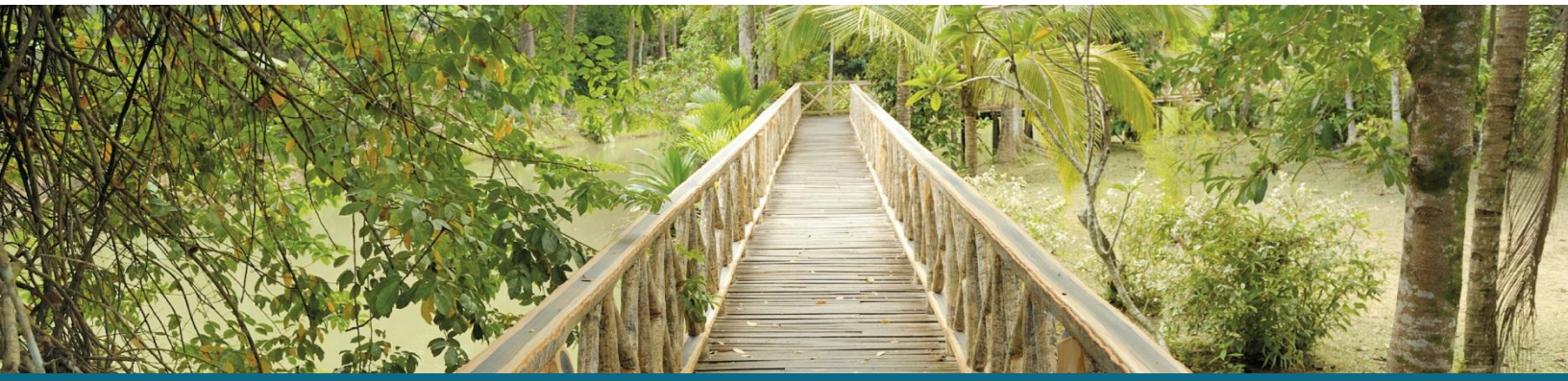
Seminar

7

Ecosystem Services: Forecasting and Next Steps

Speaker

Janet Ranganathan



GORDON AND BETTY MOORE FOUNDATION

The Nuts and Bolts of an Ecosystem Services Approach

by Janet Ranganathan, World Resources Institute

INTRODUCTION

The Moore Foundation and World Resources Institute share similar missions, both of which emphasize the concept of sustainable use of ecosystems by humans. However, translating sustainable use of ecosystems into operational terms is challenging. Use of what, by whom, with what trade-offs, where, when, and to whom? The 2005 Millennium Ecosystem Assessment (the Assessment) provided a framework that can help answer these and other questions. The Assessment was a global audit of the world's ecosystems four years in the making, commissioned by the United Nations Environment Programme in partnership with over 1,300 experts worldwide from 95 countries. What made the Assessment especially unique was that it assessed the condition of ecosystems on the basis of the services and benefits they provide to humans. In choosing to focus on ecosystem services rather than biodiversity, the Assessment helped advance the concept of ecosystem services in three important ways:

1) By including public and private decision makers, the Assessment moved awareness of ecosystem services beyond the scientific community. And the Assessment's findings—that nearly two thirds of ecosystem services assessed were degraded, putting at risk business and economic development goals—helped catapult the concept of ecosystem services on to the agenda of business and governments.
2) By providing a robust conceptual framework for understanding the links between conservation and economic goals the Assessment provided an approach to reconcile the agendas of the development and conservation communities (Figure 22: Millennium Ecosystem Assessment conceptual framework). The framework is versatile in its application—those working in the economic development community can start with the elements of human well-being in the framework, such as health or food, and make the connections to ecosystem services. The environmental conservation community, on the other hand, can start with an analysis of biodiversity and ecosystems and assess their relevance to economic development goals in terms of dependence and impacts.
3) By providing a robust conceptual framework for understanding the links between conservation and economic goals the Assessment provided an approach to reconcile the agendas of the development and conservation communities (Figure 22: Millennium Ecosystem Assessment conceptual framework). The framework is versatile in its application—those working in the economic development community can start with the elements of human well-being in the framework, such as health or food, and make the connections to ecosystem services. The environmental conservation community, on the other hand, can start with an analysis of biodiversity and ecosystems and assess their relevance to economic development goals in terms of dependence and impacts.

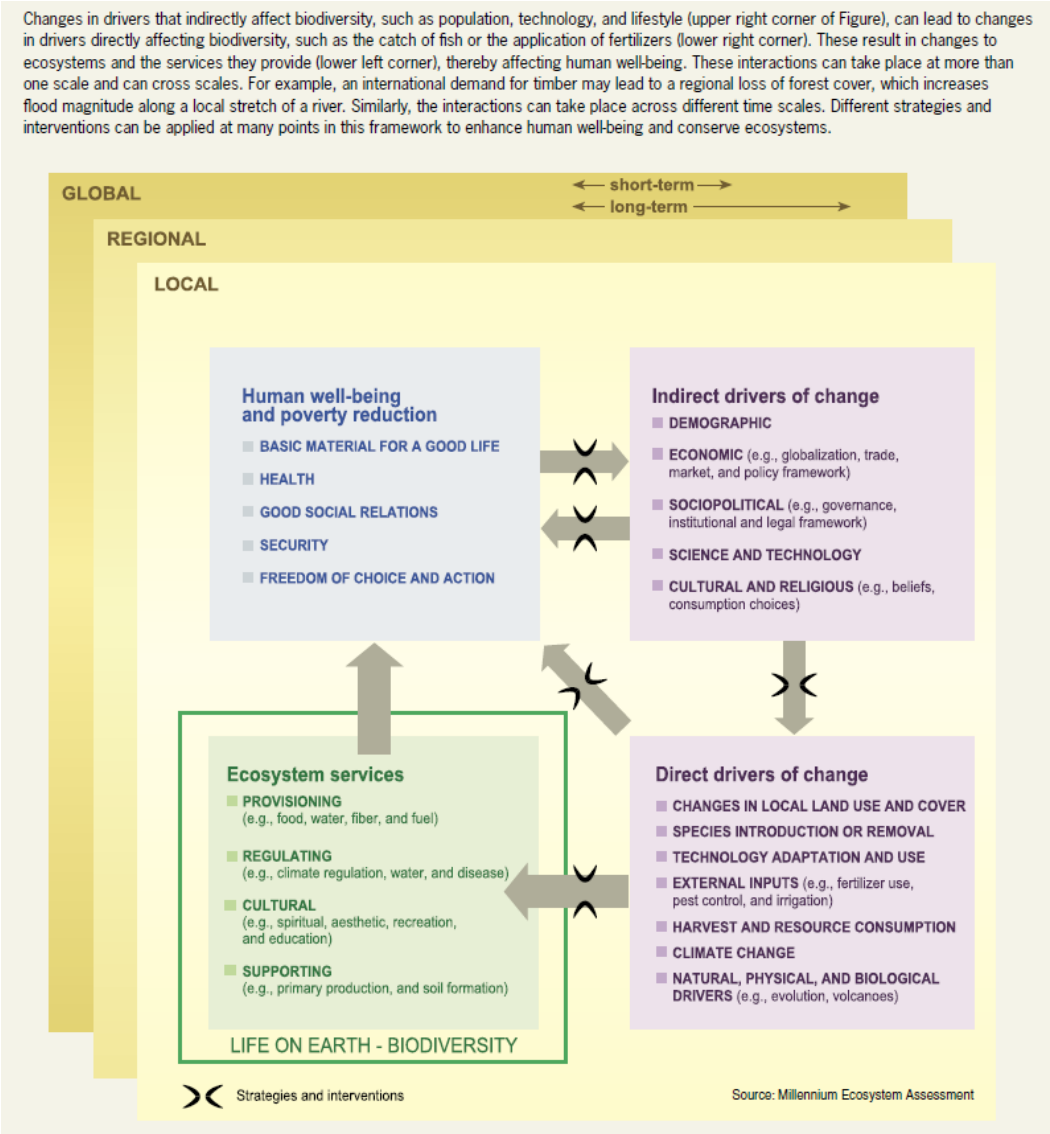


Figure 22: Millennium Ecosystem Assessment conceptual framework of interactions*. Framework represents interactions between biodiversity, ecosystem services, human well-being, and drivers of change.*

WHAT IS AN ECOSYSTEM SERVICES-BASED APPROACH?

An ecosystem services approach, as discussed in this paper, focuses on the linkages between ecosystems and economic development goals (nature for people's sake). It targets the "sweet spot" where conservation and economic development goals intersect (see Figure 23).

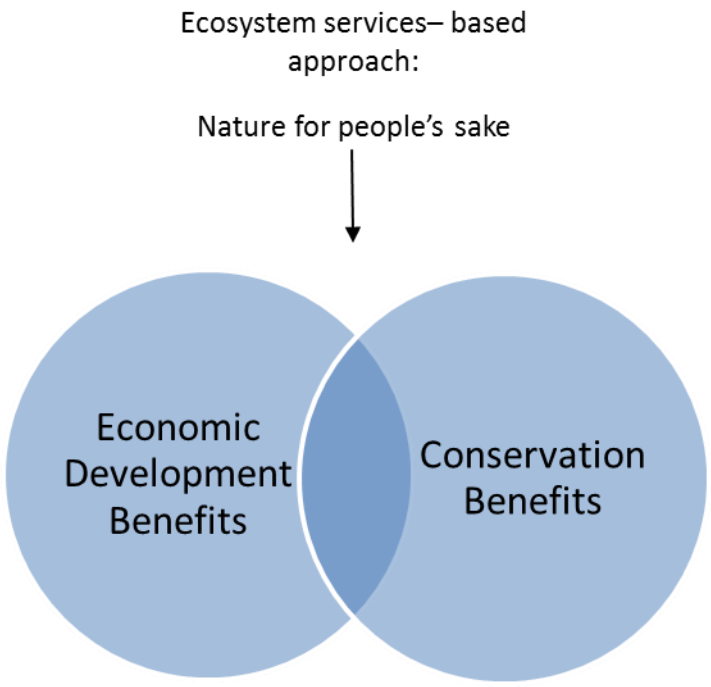


Figure 23: An ecosystem services approach.

Given the resource demands of a growing global middle class that is expected to triple from 1.8 billion (2009-10) to 4.8 billion (2030), making the case for conserving nature for nature's sake will likely be an increasingly hard sell to decision-makers preoccupied with more pressing goals, such as poverty reduction, energy security, access to freshwater, and food security. An ecosystem services–based approach can show how investing in the restoration, maintenance, and enhancement of ecosystem services can help achieve economic development benefits.

In doing so, it can help provide conservation practitioners with access to economic development funds from international donors and national governments, which are typically greater than those available for biodiversity or conservation. It can incorporate a variety of tools and policies; for example, ecosystem service dependency and impact assessments, trade-off analysis, valuations, and payments for ecosystem services. And it can be integrated into existing decision processes, such as environmental impact assessments (EIAs), cost-benefit analyses, economic assessments, environmental management systems, and national economic accounts.

Drawing on experience collaborating with government agencies and businesses such as the United Nations Poverty and Environment Initiative, the U.S. Department of Agriculture, partners in Belize, and the World Business Council for Sustainable Development, WRI has identified three broad applications of an ecosystem services–based approach:

1) Making the case for investing in ecosystems to achieve economic development goals
2) Advancing policies and incentives for sustaining ecosystems
3) Providing a systematic way of managing ecosystem service trade-offs

ECOSYSTEM SERVICES-BASED APPROACHES IN PRACTICE

The following examples in Table 1, from the work of WRI and others, each illustrate one or more of the three applications of an ecosystem services–based approach. Additional information is available in Appendix 1.

Table 1: Examples of ecosystem services based approaches.

	Making the case	Advancing policies, markets, & governance reforms	Providing systematic management of trade-offs
Sebago Lake, Maine, United States Natural water filtration provided by forests has long ensured clean water for the water district of Portland, Maine. Expanding development now threatens water quality and may cause Portland to lose its EPA-issued filtration waiver. An estimated US $101 million would be needed for a filtration plant to ensure water quality. Conversely, a comparatively small US $33.6 million investment in restoring the upstream ecosystem will maintain water quality while helping to preserve the area's natural assets.	✓	✓	
Humber Estuary, United Kingdom Maintaining aging traditional flood defenses along the Humber Estuary in the United Kingdom will cost an estimated US $101 million. But restoring intertidal habitat spaces and moving "hard" defenses further inland through a process known as managed realignment, drops the cost of coastal protection to US $64 million.	✓		
Tualatin River, Oregon, United States Clean Water Services, a wastewater and stormwater utility in Washington County, Oregon, implemented an ecosystem services approach to help meet temperature requirements for wastewater discharge. Rather than installing a new chiller (at an estimated 20-year cost of US $101-$255 million), the utility opted to manage temperatures by establishing riparian forests that would provide shade, and to augment stream flows with releases of water from upstream reservoirs. The alternative plan saved US $50.5 million.	✓		
Agroforestry in Niger Niger was a country ravaged by deforestation and desertification, brought about in large part by the clearing of land for crops. Tree regeneration has transformed heavily cropped and degraded savannas into fertile land densely studded with trees, shrubs, and crops. When planted with crops, trees act as windbreaks to counter erosion, increase soil fertility by providing enriching mulch and fixing nitrogen in root systems, and provide a valuable source of wood and fodder. Soil fertility and crop harvests have risen, spurring better diets, improved nutrition, higher incomes, and increased capacity to cope with drought.	✓	✓	
Conservancies in Namibia Under apartheid-era law, game animals were declared protected, state-owned assets, so those who inhabited communal areas had little incentive to join in conservation efforts. The 1996 Nature Conservation Act enabled the establishment of conservancies within the state's communal lands. The conservancies gave local communities guaranteed rights to benefit from the land, while decentralizing land management and putting it into the hands of the people on whom it has the biggest impact. The conservancy program now includes more than 14 million hectares in 64 registered conservancies, covering 17.6% of the country.	✓	✓	

	Making the case	Advancing policies, markets, & governance reforms	Providing systematic management of trade-offs
Corporate Ecosystem Services Review (ESR) The corporate ESR helps managers develop strategies to manage business risks and opportunities arising from a company's dependence and impact on ecosystems. Over 200 companies have used it. For example, Mondi was spurred by its corporate ESR results to increase invasive species clearing by 30%, thereby protecting water sources and generating revenues from biomass fuel.	✓	✓	✓
Shrimp Aquaculture, Tha Po Village, Thailand The proliferation of shrimp farms in Southeast Asia has driven widespread conversion of mangrove forests. A study of mangrove conversion near Tha Po village in Thailand showed that when non-marketed ecosystem services (such as coastline protection and spawning ground for wild fish) are considered in an economic analysis, intact mangroves have a net present value of US $35,696 per hectare. Using a similar calculation and including the costs of subsidies, pollution, and restoration, the net present value of shrimp farms was found to be **negative** US $5,443 per hectare.	✓		
International Finance Corporation (IFC) Performance Standards During a recent review of its Environmental and Social Performance Standards, the IFC incorporated ecosystem services into Performance Standard 6. As a result, all new IFC investments are required to maintain the benefits arising from ecosystem services and to include systematic screening for ecosystem services risks and impacts. Additionally potential impacts on ecosystem services must be addressed in mitigation plans and compensation rules.			✓
Quito, Ecuador, Water Fund In 2000, Quito, Ecuador, established a water fund to protect upstream lands in order to maintain water flows and water quality. The fund has a regular cash flow from payments from the local water utility, hydroelectric company, and businesses (most notably a brewer). Interest income generated by the fund is used to finance forest and watershed restoration projects. By late 2010, the fund was responsible for more than 5,000 acres of restored land and over 2 million trees planted.	✓	✓	
Allegheny Energy, Canaan Valley, West Virginia, United States Allegheny Power used an ecosystem services–based approach to value its 4,800-hectare Canaan Valley property in West Virginia. Traditional valuation appraised the property at US $16 million, but when the company commissioned a valuation of the site's ecosystem service benefits, the new appraisal came in at US $33 million. Allegheny Power subsequently sold the property for US $16 million to the U.S. government, which merged it with an existing wildlife refuge. The company thus secured several million dollars in tax savings by taking advantage of "bargain sale" provisions in the federal tax code.	✓		
Coral Reef Valuation in Belize Belize's coral reefs are under threat from warming oceans, overfishing, pollution, and poorly regulated coastal development. But recently, influenced by an economic valuation of the reefs, the government has taken several important steps to protect them, including tightening a number of critical fishing regulations. Additionally, after a container ship ran aground on a reef, the government sued for damages on the basis of the reef's economic value. The favorable ruling was eventually overturned, but the case nonetheless represents a turning point in the government's approach to conserving reef ecosystems.	✓	✓	

WHAT ARE KEY BARRIERS TO SCALING AN ECOSYSTEM SERVICES-BASED APPROACH?

In the approximately seven years since the release of the Millennium Ecosystem Assessment, the ecosystem services approach has begun to make its way into the language and practices of development organizations, business and financial institutions, and governments. But there is still a long way to go. Governments in particular are lagging in embracing methodologies that demonstrate the real value of the resources they govern. And while awareness and use of the ecosystem services concept is increasing, a steady stream of news reports and findings from more recent assessments suggest that the overall trends documented in the Assessment have not changed significantly. Global ecosystem degradation continues to endanger economic development goals. Forests continue to be cleared and degraded, overfishing is still widespread, the march of increasing water scarcity continues onward, and food production remains a major source of environmental degradation.

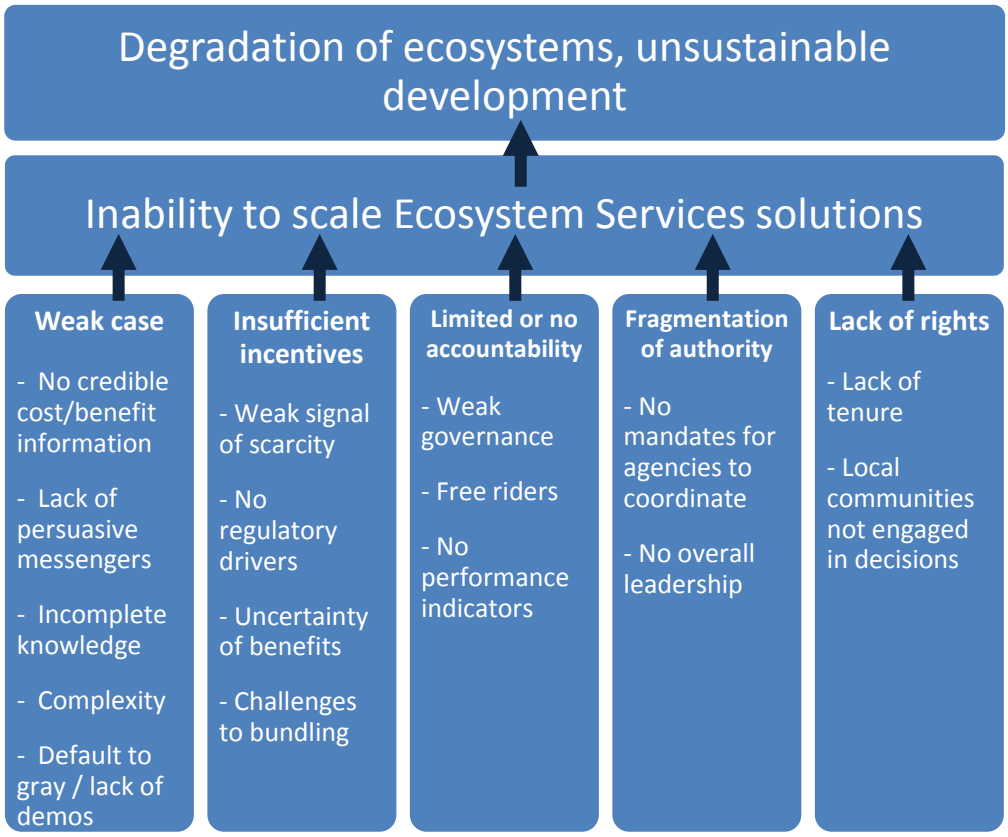


Figure 24: Barriers to scaling ecosystem services based solutions (not exhaustive).

WRI has identified five key barriers to scaling up ecosystem services–based approaches (see Figure 24) (Irwin and Ranganathan 2007).

1) **A weak case for investing in ecosystems to achieve economic development benefits.**
   - *No credible cost-benefit information.* Given the limited experience with investing in ecosystem services, there is still a dearth of quantitative data about the costs and benefits of investing in natural capital versus alternative options. Even with this information, there are limitations to the cost-benefit approach in identifying ecosystem service trade-offs in decision-making.
   - *Lack of persuasive messengers.* The current champions for investing in ecosystems as solutions to economic development issues are primarily within academia and conservation non-governmental organizations (NGOs). More champions are needed within mainstream government agencies/ministries, companies, and investors.

- *Incomplete knowledge.* Our knowledge of the flow of ecosystem services due to specific ecosystem management practices is incomplete. More investment is needed in measuring and monitoring ecosystem services — and decision-making processes should be closely tied to any changes and growth in knowledge. If policy and practice get too far ahead of the science, it could eventually contribute to a backlash or default in credibility. Knowledge, policy, and practice must co-evolve.
- *Complexity.* Managing for ecosystem services can be complex. For instance, the mechanisms for generating ecosystem services–related credits or receiving payments can be convoluted and unwieldy for many businesses and landowners. Investment screening tools have been developed to identify dependencies on ecosystem services and the risks of disruption of those services, as well as the potential benefits of restoring such services. But these tools are not widely applied because they are too complicated and not yet sufficiently user-friendly or well-adapted to real-world situations.
- *Default to gray.* Local governments and many other decision-makers still tend to default to non-ecosystem-based solutions for their development needs (e.g., water supply, shoreline protection, flood mitigation, food security). Such default to "gray" solutions (human-made solutions typically involving technology, concrete, and/or steel) instead of "green" solutions could be out of habit, old administrative requirements, a predilection for "engineered" solutions by decision-makers trained in engineering (the "engineers conundrum"), a belief that gray options are economically superior to green ones, and/or a belief that gray options give greater performance certainty and thereby greater regulatory compliance certainty.
- *Lack of successful demonstrations.* There are still relatively few large-scale "success stories" with hard data on the costs, benefits, and political economy dynamics that led to investments in ecosystems. We need more iconic examples to raise awareness, provide insights, and inspire replication.

2) **Insufficient incentives:** regulations and markets need to explicitly value ecosystem services in order to provide increased incentives for investing in their protection and restoration.
   - *Weak signals of scarcity.* Many entities (e.g., cities, nations, companies) currently enjoy the benefits of ecosystem services for free. Absent a strong physical or regulatory signal of immediate scarcity, why would any of those entities start paying for those services or adopt policies that put restrictions on the use of those services, or activities that lead to their loss?
   - *Insufficient regulatory drivers.* Investment in ecosystems to deliver needed services has occurred in situations where there is government regulation requiring the service to be maintained at a sufficient level or quality. The investments currently being undertaken in Sebago Lake and the Crooked River watershed, for example, are motivated by the need to maintain an EPA-regulated filtration waiver. Similarly, the often-cited investments by New York City in source water protection in the Catskills were motivated by drinking water standards. The Willamette Partnership riparian restoration investment (temperature trading) was underpinned by requirements under the Clean Water Act and the Endangered Species Act (for salmon). In some places such policy or regulatory drivers are absent and in others the ecosystem services movement arguably has not sufficiently leveraged existing laws to push for ecosystem-based solutions.
   - *Uncertainty of benefits.* Natural ecosystems are unpredictable, and there is uncertainty about the level and extent of ecosystem services that will be provided by a given investment in natural capital. Risk factors are also uncertain. Practitioners need better tools for accounting for and, when possible, for offsetting the elements of uncertainty in their ecosystem services–based solutions.
   - *Challenges to bundling services.* Multiple revenue streams are often needed to trigger the protection and restoration of ecosystem services, yet obstacles remain for efficiently rewarding investments that generate a range of types of ecosystem services

3) **Limited or no accountability:** people are not held accountable for ecosystem degradation and adverse impacts on the flow of ecosystem services.
   - *Weak governance and/or lack of capacity.* In some countries, poorly developed, decentralized institutional mechanisms for ensuring full participation, transparency, and accountability in decision-making related to the management of ecosystem services undermine equitable benefit-sharing arrangements.
   - *Free riders.* Ecosystems and their services can have multiple beneficiaries. For instance, in the example of the Quito water fund, the erosion control afforded by riparian forests benefits nearby farmers as well as downstream municipal water treatment plants, hydroelectric facilities, and breweries, to name a few. But the brewery would not be willing

to finance riparian restoration on its own, since the treatment plant and power company also benefit from the reduced river siltation. Why should the brewery pay when the others would benefit without paying?
- *No performance indicators.* Decision-makers and resource users are not held accountable to performance standards for protecting or restoring ecosystem services.

4) **Fragmentation of authority:** weak leadership and insufficient institutional mandates with respect to integrating a consideration of ecosystem services into decision-making and managing trade-offs.
   - *No mandate for entities that manage ecosystems to coordinate.* Many ecosystem services are generated over a large landscape that has multiple owners. Coordinating land management practices in order to ensure sustainability and the provision of desired services is often difficult with many different owners.
   - *No overall leadership.* There is a need for more charismatic champions of sustainably managing ecosystems for the sake of ecosystem services. The ecosystem services movement currently lacks institutional support at the local, national, and international levels; while networks and forums to enable collaboration are emerging, more cooperative action is needed.

5) **Lack of rights:** communities are not engaged.
   - *Lack of tenure and property rights.* In many countries, a lack of clear property rights impedes the ability of individuals or local communities that manage ecosystems to control access to and use of these ecosystems and to benefit from their improved management. Without this ability to benefit from management of an ecosystem, the incentive for sustainable management diminishes.
   - *Local communities not engaged in decisions.* Local communities continue to face problems in accessing information, and suffer inadequate provisions for full, equitable, and representative participation.

The most relevant barriers vary from case to case depending on the nature of the ecosystem services, geography, and other issues. For example, in the case of Niger's agro-ecosystems, the most significant barriers to restoring ecosystem services were related to lack of tenure, lack of community engagement, and rural producers' lack of management rights to trees on their farms. These factors, in combination with poor permitting systems and marketing constraints, prevented rural producers from capturing the full economic benefits of farmer-managed natural regeneration. In the case of the adoption of green infrastructure solutions for protecting water supplies for the city of Portland, Maine, key barriers were related to the need for credible cost-benefit information, a tendency by decision-makers to default to gray solutions, uncertainty of benefits, and lack of persuasive messengers.

WHAT ARE PROMISING OPPORTUNITIES FOR SCALING UP ECOSYSTEM SERVICES-BASED SOLUTIONS?

National and local governments are important targets of influence for scaling up ecosystem services–based solutions. Governments at the national and local levels are well-positioned to reform policies, enact regulations, improve governance, strengthen institutions, increase accountability, and otherwise establish more favorable enabling conditions for sustaining ecosystem services. Businesses, development agencies, NGOs and civil society, and the media should be viewed as means to ultimately influence decision-makers in government.

In terms of engaging national governments, WRI has found that it is more effective to make specific links between ecosystem services and their existing priorities, rather than advocating for them to generally adopt ecosystem services as a decision-making framework. A number of current national government priorities depend on ecosystem services. These include food security, climate adaptation, and access to freshwater.

The protection, management, or restoration of ecosystem services could be part of a cost-effective response to addressing these challenges. In addition, the incorporation of ecosystem services in the IFC's performance standards represents an opportunity to scale up an ecosystem services approach within the financial community.

There are now dozens of international and regional initiatives aimed at improving food security and nutrition through increased investments in agricultural development. In response to increasing risks of water scarcity, multiple initiatives and programs are emerging to invest in improving water supplies. Food and water security are increasingly being targeted in development assistance programs, in response to increasing political pressures and widespread recognition of the growing threats associated with burgeoning demand and constrained supplies and access to food and clean water. Issues of food and water security are often compounded by climate change, and efforts to improve food and water security through ecosystem services–based solutions can also contribute to climate change mitigation, adaptation, and increased resiliency, and interventions piloted by the Vulnerability and Adaptation Initiative. The ecosystem-based approach to improving food and water security can also be positively linked to protection of forests.

WHAT TYPES OF POLICY INTERVENTIONS CAN BE USED TO INFLUENCE THE FLOW OF ECOSYSTEM SERVICES?

Types of policies for sustaining ecosystem services extend beyond the often-cited payments for ecosystem services (e.g., carbon markets for forests). A growing list of innovations in other policy arenas show promise for sustaining ecosystem services (see Table 2). These can be broadly categorized as:

- national and subnational policies
- economic and fiscal incentives
- sector policies
- governance

Table 2: Policy options for sustaining ecosystem services. *For additional information, including potential value for sustaining ecosystem services, challenges in design and implementation, and examples of experience, please refer to Appendix 2.*

Policy Category	Policy Options
National and sub-national policies	• Establish protected areas • Mainstream ecosystem services into economic and development planning • Include investments in ecosystem services in government budgeting
Economic and fiscal incentives	• Use tax deductions and credits to encourage investment in and purchase of ecosystem services • Establish fees for use of resources or services • Use taxes or other public funds to pay to maintain regulating and cultural services • Reduce perverse subsidies • Set limits and establish trading systems for use of ecosystems and their services • Fund valuation of ecosystem services and research into improving valuation methods • Use procurement policies to focus demand on products and services that conserve ecosystem services • Support wetland banking schemes
Sector policies	• Include ecosystem services in sector policies and strategic environmental assessments • Set targets to encourage use of renewable energy • Require ecosystem management best practices in granting licenses or concessions • Use zoning or easements to keep land available for priority ecosystem services • Use regulatory ecosystem services such as natural hazard protection or water filtration instead of built structures • Establish certification schemes that encourage best management practices • Introduce education or extension programs on good practices • Develop and encourage use of products and methods that reduce dependence and impact on ecosystem services
Governance	• Clarify or strengthen local community rights to use and manage ecosystem services • Develop and use private- and public-sector indicators for ecosystem services • Establish processes to work across levels of government, from local to national • Ensure public access to information and participation

Some interventions fit into more than one category. For example, conservation easements can be viewed both as an economic incentive and as a sector policy. The appropriateness of a policy for any given situation will depend on a number of factors, such as political buy-in, presence of existing legal authority, and institutional capacity.

On a cautionary note, despite over a decade of experience of creating policy interventions to protect and sustain ecosystems and their services, there have been few evaluations of the effectiveness of these solutions in regard to meeting their conservation or socioeconomic goals. And there has been almost no effort to assess the cost-effectiveness of such policy interventions (Ferraro et al. 2011).

Given that much uncertainty remains about how ecosystems function, it is critical to design robust monitoring as part of an adaptive management approach. This turns the management of ecosystem services into a series of experiments. It tests hypotheses about how the components of an ecosystem function and interact. Based on monitoring, policies and management practices can be continually adjusted and course corrections made to ensure they achieve their goals.

CONCLUSIONS

Over the past 50 years, economic development policies have too often unwittingly diminished nature's capacity to provide the goods and services people depend on. As a result, 15 ecosystem services have been degraded globally in the past 50 years, while another 5, such as water regulation and the supply of timber, hang in the balance. This decline in ecosystem services is jeopardizing the attainment of economic development goals that depend on ecosystem services, such as food and freshwater security.

If the world is to sustainably feed and provide freshwater to nine billion people in 2050 *and* successfully navigate ecological tipping points in the face of climate change, we will need to change the way we use and manage ecosystems. And we will need to ensure that economic development decisions explicitly take ecosystem services into account and reduce trade-offs across services.

An ecosystem services approach can help in three ways. First, it can help make the case for investing in the restoration, maintenance, and enhancement of ecosystem services to attain economic development goals. Second, it can build support for policies, markets, and governance reforms that sustain ecosystem services. Third, by systematically assessing the dependence and effect of any decision, plan, or policy on ecosystem services, decision-makers can proactively identify and manage ecosystem trade-offs.

National governments should be an important target for advancing an ecosystem services approach. Progress can be made on a number of priorities on the political agenda, such as food and water security and climate change, by advancing investments in ecosystems.

Markets for, or more specifically payments for, ecosystems' regulating services, such as carbon sequestration and water filtration, have become popular in recent years. But payments for ecosystem services are not the only mechanism for aligning economic incentives with sustaining ecosystem services. Others include subsidies, policies, land-use zoning, and governance reforms.

APPENDIX 1: CASE STUDIES OF ECOSYSTEM SERVICES–BASED SOLUTIONS

Sebago Lake, Portland, Maine, United States: Protecting Forests to Protect Water

WRI and its partners identified Sebago Lake as a promising opportunity to make the case for investing in forest protection on the basis of preserving freshwater supplies. Sebago Lake and the Crooked River watershed supply water to the Portland Water District — 25 million gallons of water to nearly 200,000 people on a daily basis. On the basis of the natural water filtration services provided by upstream forests, Portland Water District has an EPA Clean Water Act exemption for water filtration requirements. But with expanding development and deforestation, the waiver is in danger. Loss of the waiver would cost the city around US $101 million in upgrades and new water treatment infrastructure.

Using an ecosystem services approach, WRI has demonstrated that a comparatively small investment of around US $33.6 million in restoration, through afforestation and reforestation, the establishment of conservation easements, and other measures, will ensure high water quality for years to come while helping to preserve the area's natural assets. WRI is continuing to help make the case to beneficiaries for investing in maintenance and restoration of the Crooked River watershed. Barriers that are being addressed include expanding the traditional engineering analysis of alternative water treatment options to include ecosystem approaches, addressing ecological risks such as fires and disease, and securing political support and funding to cover the costs of watershed conservation measures.

Humber Estuary, United Kingdom: Cost-Effective Coastal Flood Protection

Much of the aging flood defense infrastructure along the English coastline is nearing the end of its effectiveness, and the need for significant investment looms in the near future. Given concerns about sea-level rise and increasing severity and frequency of storms, planners are considering alternative options such as managed realignment, which allows for the restoration of intertidal habitat space by moving hard sea defense farther inward. A recent study found that in many scenarios, managed realignment is more economically efficient than maintaining the current approach over a 25-year period —– US $64 million versus US $101 million (Turner et al. 2007).

Tualatin River, Oregon, United States: Reducing Thermal Pollution Costs

When Clean Water Services, a wastewater and stormwater utility in Washington County, Oregon, was faced with the prospect of installing a new water chiller in order to meet a temperature requirement for its wastewater discharges, it selected an ecosystem services–based solution. The 20-year cost estimate for installing and operating a man-made chiller came in at US $101-$255 million (Cochran and Roll 2008). Instead, Clean Water Services developed a plan to reduce costs by US $50.5 million by establishing riparian forests that would provide shade to water upstream of the wastewater facilities, and to augment stream flows with releases of water from upstream reservoirs. In 2004, the Oregon Department of Environmental Quality approved the plan, the first of its kind in the United States. Since 2005, more than a half-million native trees and shrubs have been planted.

Agroforestry in Niger: More Trees, More Grain

Agroforestry, the integration of trees into food crop landscapes to maintain a green cover year-round, was a traditional African farming practice until the arrival of colonial influence and the mindset that trees and crops should be separated. Trees were removed from vast expanses of land across Africa, and creeping desertification ensued (Ranganathan and Hanson 2011).

Over the past 20 years, however, development agencies and NGOs have led tree regeneration and planting efforts in Niger, transforming heavily cropped and degraded savannas into fertile land densely studded with trees, shrubs, and crops. The movement grew after pilot projects demonstrated that when planted with crops, trees act as windbreaks to counter erosion, increase soil fertility by providing enriching mulch and fixing nitrogen in root systems, and provide a valuable source of wood and fodder. For good measure, they also sequester carbon dioxide from the atmosphere. The scale of the change is impressive, affecting more than 5 million hectares of land — an area about the size of Costa Rica (Tappan 2007).

By 2007, between a quarter and a half of the country's farmers were involved, and about 4.5 million people were reaping the benefits (Reij 2008). Soil fertility and crop harvests have risen, spurring better diets, improved nutrition, higher incomes, and increased capacity to cope with drought (see Figure A1). And with farmers producing more fuel wood, Niger's previously shrinking forests have been spared further destruction.

A combination of factors underpinned Niger's transformation, but three stand out:

1) Investment in simple, low-cost techniques for managing the natural regeneration of on-farm trees and shrubs, alongside improved soil and water conservation techniques (World Vision Australia 2010)
2) A shift away from forest protection as the State's exclusive responsibility to expanded farmer support and use of farmer-to-farmer visits to spread improved practices (World Resources Institute et al. 2008.)
3) Tree tenure reform. In post-colonial Niger, the government claimed ownership of forests and strictly controlled the harvesting of trees. Farmers were fined or even imprisoned for harvesting trees without a permit or for simply lopping branches. But between 1998 and 2004, government tenure reforms relaxed the rules, tipping the balance toward farmer self-interest in regenerating and managing trees on their land.

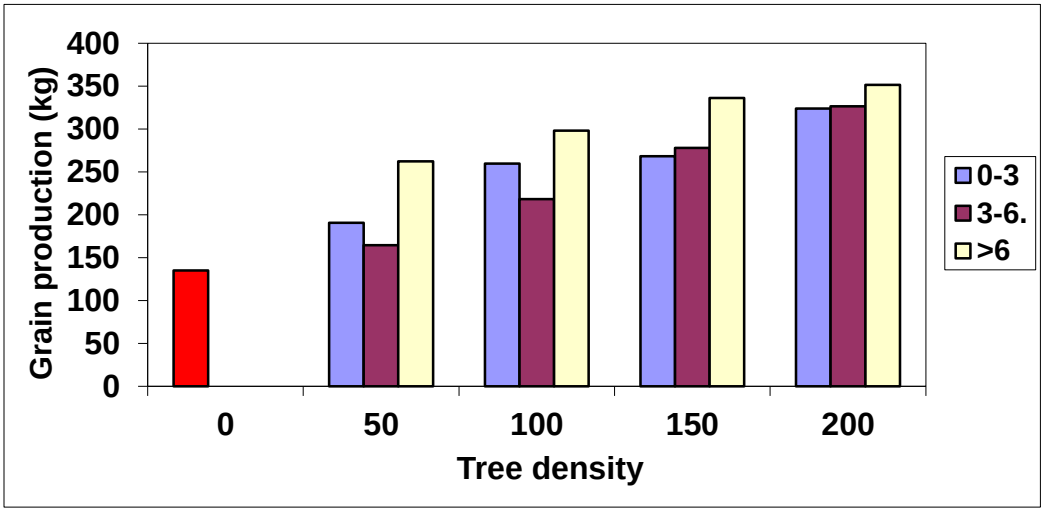


Figure A1: More trees, more grain. *Source: M. Larwanou, 2011, African Forest Forum.*

Agroforestry has potential well beyond Niger. Similar initiatives for farmer-managed natural regeneration are now underway in Zambia, Malawi, and Burkina Faso, suggesting that agroforestry may be applicable to a broad range of food crop systems in Africa. To be successful, however, these need to be accompanied by the kind of governance reforms embarked on in Niger, blanket extension efforts, and strong buy-in from farmers (Garrity et al. 2010; Hertsgaard 2011).

Note: The full case study that this summary is drawn from is available in *World Resources 2008: Roots of Resilience — Growing the Wealth of the Poor* (World Resources Institute et al. 2008).

Conservancies in Namibia: Supporting Income and Increased Wildlife Abundance

In the early 1980s, Namibia's rich natural assets were under serious threat. Ecosystems in the north were rapidly deteriorating; drought-prone land was severely overused, poaching of elephant ivory and rhino horn was rampant, and wildlife populations plummeted (World Resources Institute et al. 2005).

Under apartheid-era law, game animals were declared to be protected, state-owned assets, and those who inhabited communal areas had little incentive to join in conservation efforts (World Wildlife Fund and Rossing Foundation 2004). But in the mid-1980s, conservationists and others began to push for more user rights. Finally, in 1996, the Nature Conservation Act enabled the establishment of conservancies within the state's communal lands. The state devolved limited wildlife rights (including hunting, capture, culling, and sale of huntable game) to conservancy communities. To qualify, applicant communities

had to elect a representative committee, negotiate a legal constitution, prove the ability to manage funds, and produce an acceptable plan for equitable distribution of wildlife-related benefits (Long 2004). Once approved, registered conservancies acquired rights to a sustainable wildlife quota.

The conservancies gave local communities guaranteed rights to benefit from the land, while decentralizing land management and putting it into the hands of the people on whom it has the biggest impact. Previously, wild predators imposed significant costs on rural herding communities, but with the introduction of conservancies, local people could benefit from wildlife. The conservancy program now includes more than 14 million hectares in 64 registered conservancies, covering 17.6% of the country (Weaver 2011). Thirty-one of the conservancies are adjacent to national parks or key corridors between the parks, and have benefited the parks by reducing poaching and promoting compatible land nearby. As of May 2011, the conservancy program in Namibia had generated over US $28 million in cumulative economic benefits since the program was launched in the mid-1990s (Weaver 2011).

Note: The full case study that this summary is drawn from is available in *World Resources 2005: The Wealth of the Poor – Managing Ecosystems to Fight Poverty* (World Resources Institute et al. 2005).

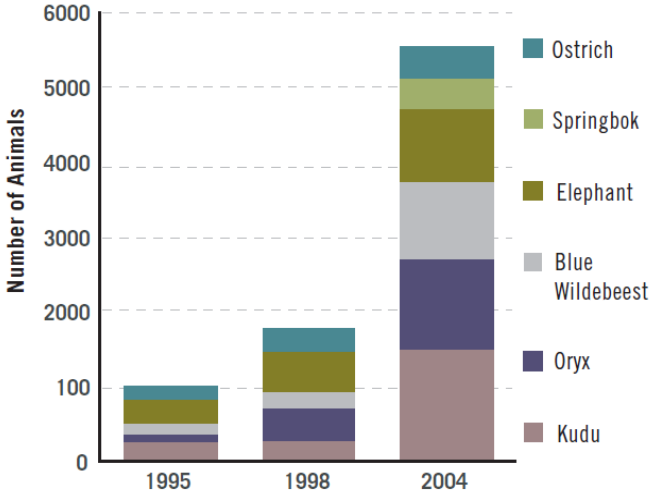


Figure A2: Wildlife recovery in Nyae Nyae Conservancy. *Source: World Resources Institute et al. (2005).*

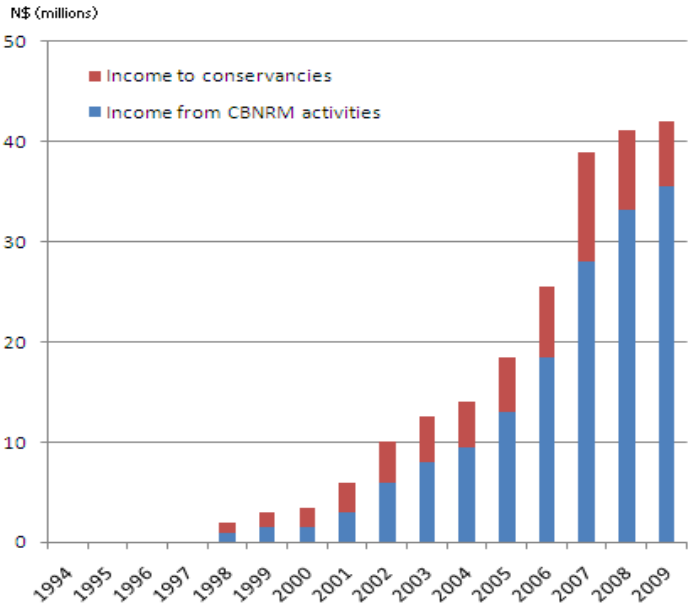


Figure A3: Income from Namibian conservancies. *Source: Chris Weaver, WWF/Namibia.*

Corporate Ecosystem Services Review: Assessing Business Risks and Opportunities from Dependence and Impacts on Ecosystem Services

In partnership with the Meridian Institute and World Business Council for Sustainable Development, the World Resources Institute developed the Corporate Ecosystem Services Review (Corporate ESR) (Hanson et al. 2008). The Corporate ESR is a structured methodology that helps managers proactively develop strategies to manage business risks and opportunities arising from a company's dependence and impact on ecosystems. Since it was launched in 2008, over 300 companies have used it, with several striking successes that have benefited both the companies and the ecosystems their profits depend on.

For example, Alcoa protected its license to operate at a Canadian aluminum smelter by investing in ecosystems to reduce noise and protect the water catchment. European paper company Mondi was spurred by its Corporate ESR results to increase invasive species clearing by 30%, thereby protecting water sources and generating revenues from biomass fuel. The business community is developing a stronger understanding of the linkages between environmental benefits and profits, and ecosystem services practitioners can provide the tools businesses need to make sound decisions.

An Economic Analysis of the Impacts of Shrimp Farms on Ecosystem Services and People

The expansion of shrimp aquaculture, particularly in Southeast Asia and Central America, has increased profits for a few growers while supplying the global marketplace with low-cost shrimp. Unfortunately for many coastal communities in Southeast Asia, the proliferation of shrimp farms has driven widespread destruction and conversion of mangrove forests (Stevenson 1997).

A study of mangrove conversion near Tha Po village in Thailand compared the economic returns from shrimp farms with those from sustainably managed mangroves (Sathirathai and Barbier 2001). Conversion of mangroves to shrimp farms appears the economically sound choice when only the values of the shrimp harvest and forest products are considered in the economic analyses (a net present economic value of US $8,340 per hectare as aquaculture space, versus US $823 per hectare as intact mangroves). However, if the value of non-marketed ecosystem services from mangroves (such as coastline protection and spawning ground for wild fish) is considered, the intact mangroves become the more sound development choice (US $35,696 per hectare). Under a similar calculation, the net present value of shrimp farms was found to be negative US $5,443 per hectare — this is taking into account the traditional "value" of the shrimp farm, minus the cost of subsidies, pollution, and restoration. Managing trade-offs becomes much more clear-cut when the ecosystem services approach is applied.

People in Tha Po village and other poor coastal communities where mangrove conversion is occurring bear most of the costs associated with diminished ecosystem services, including lost forest resources, reduced coastline protection from storms, lower fishery yields, and water quality degradation from aquaculture pollution. Yet they receive few of the benefits, which primarily accrue to shrimp aquaculture operators and distant consumers who enjoy subsidized shrimp. If residents had been involved in the decision and provided with information about their use of ecosystem services in a cost-benefit analysis, might a more equitable and economically sound decision have been made?

The International Finance Corporation: Incorporating Ecosystem Services in Investment Safeguards

The International Finance Corporation's (IFC) Performance Standards define clients' roles and responsibilities for managing their projects and the requirements for receiving and retaining IFC support (International Finance Corporation 2012). During a recent review of its Environmental and Social Performance Standards, the IFC incorporated ecosystem services into Performance Standard 6. As a result, all new IFC investments are required to maintain the benefits arising from ecosystem services and to include systematic screening for ecosystem services risks and impacts. Potential impacts on ecosystem services need to be addressed in mitigation plans and compensation rules. This is potentially a significant ecosystem services–based success outcome, if adequately implemented, for the following reasons:

- It will affect the IFC's investment portfolio (US $18 billion in 2010), as well as the practices of investment partners within government and the private sector.
- The World Bank is looking at the IFC policies as it updates its own safeguards.
- The 60+ Equator Principle banks are expected to link their own performance standards to those of the IFC.
- Banks in China and Brazil may use the IFC's policies as they develop their own standards.
- Most OECD export credit agencies have linked their standards to the IFC.

Quito, Ecuador: Water Fund

In 2000, Quito, Ecuador, established a water fund to protect upstream lands in order to maintain water flows and water quality. The fund was conceptualized and promoted by The Nature Conservancy (TNC), and started with about US $21,000 from TNC, USAID, and others (Porras and Neves 2006). Regular cash began flowing in with consumption-based payments from the local water utility, hydroelectric company, and businesses (most notably a brewer). Interest income generated by the fund is now used to finance forest and watershed restoration projects. By late 2010, the fund was responsible for more than 5,000 acres of restored land and over 2 million trees planted (Whelan 2010).

Allegheny Energy, Canaan Valley, West Virginia

The U.S.-based electric utility Allegheny Power took an innovative ecosystem services–based approach when it embarked on divesting its 4,800-hectare Canaan Valley property in West Virginia (Bayon 2002). Traditional approaches appraised the property, with its pristine forests, marshes, and abundant wildlife, at US $16 million. Believing the property was worth more, the company commissioned an economic valuation of the environmental benefits provided by the site. The new appraisal came in at US $33 million. Allegheny Power subsequently sold the property for the original US $16 million value to the U.S. government, which merged it with an existing wildlife refuge. But by taking advantage of "bargain sale" provisions in the federal tax code, the company was able to claim a charitable contribution of the remaining US $17 million value, thereby securing several million dollars in tax savings (Powicki 2002).

Coral Reefs in Belize

Belize is home to some of the Caribbean's largest, most stunning, and most valuable coral reefs. Reef ecosystems provide significant value to Belize's economy, through fishing, shore protection, tourism, and other services. But the reefs are under threat from warming oceans, overfishing, pollution, and poorly regulated coastal development. WRI, along with other NGOs, has worked to provide policy-makers with better information on the full value of the ecosystem services the reefs provide.

Over the past 18 months, influenced by WRI's *Coastal Capital: Belize,* an economic valuation of the nation's coral reefs, the government of Belize took momentous steps to protect this unique ecosystem (Cooper et al. 2009). For example, after the container ship *Westerhaven* ran aground on a reef in January 2009, the government decided to sue for damages, something that had not occurred with past groundings. The suit was premised on the foregone economic contribution of the damaged reef's ecosystem services, a first-of-its-kind approach in Belize history. In a landmark decision, the Belizean Supreme Court ruled in April 2010 that the ship's owners must pay the government approximately US $6 million in damages. Although the ruling was subsequently overturned on appeal, it represents a turning point in the government's approach to reef conservation.

In addition to this lawsuit, the government tightened a number of fishing regulations, including restricting the size limit of Nassau groupers and banning the harvest of parrotfish; mandating that all fish fillets brought to landing sites retain a skin patch, facilitating species identification for law enforcement; and banning spearfishing within marine protected areas. These outcomes, especially the ecosystem services–based fine, are landmarks for Belize and the Caribbean region, and perhaps for other reef-rich areas, as well. They should help relieve threats to the Mesoamerican Reef, which underpins a significant portion of Belize's GDP. For example, coral reef– and mangrove-associated tourism contribute 12% to 15% of Belize's GDP. Reefs and mangroves also protect coastal properties from erosion and wave-induced damage, providing an estimated US $231 million to US $347 million in avoided damages per year —20% of Belize's annual GDP.

APPENDIX 2: POLICY OPTIONS FOR SUSTAINING ECOSYSTEM SERVICES.

Table A1. Policy Options for Sustaining Ecosystem Services. *Source: Ranganathan et al. (2008).*

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
National and Subnational Policies			
Mainstream ecosystem services into economic and development planning	Addresses indirect drivers of ecosystem change over the longer term by including ecosystem services in poverty reduction strategies, national economic and development plans, or country assistance strategies	Overcoming separate agency mandates, integrating different skills and perspectives, aligning with other policies such as financial and economic incentives	Tanzania's 2005 National Strategy for Growth and Reduction of Poverty explicitly recognizes many of the drivers of ecosystem service degradation as impediments to poverty reduction. The strategy sets goals to address these drivers, establishes a set of poverty-environment indicators, and includes 15 environmental targets (Assey et al. 2007). Regreening of Niger: see Appendix 1.
Include investments in ecosystem services in government budgeting	Makes the crucial link between policies focused on ecosystem services and providing funds to carry them out	Improving ability to value and integrate ecosystem services in cost-benefit analyses and identifying specific investments to sustain them	The U.K. Treasury drew on the Millennium Ecosystem Assessment in preparing its comprehensive spending review of government funding. Notes that the Assessment is relevant to achieving sustainable growth, employment, security, and equity, and that the Treasury will aim to release resources to meet environmental challenges (U.K. House of Commons Environmental Audit Committee 2007)
Establish protected areas	Helps protect ecosystems and their associated services from drivers of overexploitation and conversion	Incorporating goal of sustaining ecosystem services into site selection, linking biodiversity conservation and sustaining ecosystem service goals Including local communities, taking a landscape approach that recognizes drivers of change outside the protected area, and ensuring financial sustainability	In 1986, St. Lucia designated marine reserves with the involvement of local people and businesses, leading to regeneration of mangrove forests (WRI et al. 2000, 176–77). In 1993, Austria established 20-year contracts with all forest owners requiring them to protect the land. Financial compensation was offered to owners who lost income (Hackl and Rohrich 2001). Namibia Conservancies: see Appendix 1.

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Economic and Fiscal Incentives			
Use tax deductions and credits to encourage investment in and purchase of ecosystem services	Provides economic incentive to manage ecosystems in ways that sustain services	Avoiding equity problems or protecting one service at the expense of others	U.S. law gives landowners tax deductions for donating conservation easements, which restricts use of the property to protect associated resources (United States House 2006). Allegheny Power: see Appendix 1.
Establish fees for use of resources or services	Reduces waste of resource	Avoiding equity issues, where those with lower incomes are less able to pay, and balancing number of users	In Colombia, Cauca Valley water associations voluntarily agreed to increase user fees paid to the local utility in exchange for improved watershed management. The associations aim to improve stream flow for the benefit of agricultural producers (Food and Agriculture Organization of the United Nations 2002). Quito Water Fund: see Appendix 1.
Use taxes or other public funds to pay to maintain regulating and cultural services	Creates economic incentive to supply services that do not normally have a market value	Maintaining one service at the expense of others, avoiding creating equity issues such as loss of harvest rights or ineligibility because of lack of tenure Depending on still-emerging market infrastructure such as quantification, verification, and monitoring tools Informing public about the use of funds to provide accountability	The U.K. nitrate sensitive areas (NSA) scheme uses direct government payments to compensate farmers for adopting management practices that reduced leaching of nitrates into groundwater (IUCN 2007). A Costa Rican fund mainly from fuel tax revenues pays forest owners for watershed protection (Perrot-Maître and Davis 2001). Belize charges foreign tourists a conservation fee, which funds a trust dedicated to the sustainable management and conservation of protected areas (Conservation Finance Alliance 2003).
Reduce perverse subsidies	Removes incentive for intensive production of provisioning services at expense of other services	Overcoming vested interests in maintaining subsidies, creating mechanisms to transfer reduction in subsidies to payments to maintain regulating and cultural services	As a result of the eutrophication of waterways and threats to drinking water supply, many Asian countries have reduced fertilizer subsidies, including Pakistan (from US $178 million to US $2 million per year), Bangladesh (US $56 million to US $0), and Philippines (US $48 million to US $0) (Myers 1998).

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Set limits and establish trading systems for use of ecosystems and their services	Achieves more cost-effective improvements in ecosystem services than conventional regulatory approaches	Ensuring limit is stringent enough to provide an incentive to participate Allocating permits or credits in cases of unclear property rights Keeping transaction costs manageable, especially for non-point sources	In 1980, New Jersey established tradable Pinelands Development Credits to limit development in environmentally sensitive areas and allow prospective developers to trade for development rights on available land (Landell-Mills and Porras 2002). In 1999, Australia established a water transpiration credits scheme to reduce river salinity (Brand 2005). Under its National Water Initiative, Australia sets limits on water use in the Murray Darling Basin, and as of January 2007, the basin states are able to buy and sell permanent water entitlements (Parliament of Australia 2006).
Fund valuation of ecosystem services and research into improving valuation methods	Increases societal awareness of the value of ecosystem services and strengthens cost-benefit analysis for public decisions	Dealing with techniques for valuing ecosystem services that are still in their infancy Discrediting ecosystem service approach by overestimating values	A study found that Canada's Mackenzie River watershed's 17 ecosystem services were worth nearly US $450 billion undisturbed, offering a new perspective on the economic benefits and costs of a proposed gas pipeline (Canadian Parks and Wilderness Society 2007). A study found that on a single Costa Rican farm, natural pollination by insects increased coffee yields by 20% on plots that lay within a kilometer of natural forest, a service worth approximately US $60,000 (Rickets et al. 2004). Belize reef valuation: see Appendix 1
Use procurement policies to focus demand on products and services that conserve ecosystem services	Creates incentives for suppliers to adopt approaches that are ecosystem-friendly	Avoiding high transaction costs of demonstrating responsible behavior Implementing cost-effective monitoring and verification systems	The U.K. government's timber procurement policy stipulates that timber must come from legal and sustainable sources (Central Point for Expertise on Timber 2007).

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Support wetland banking schemes	Provides a way to maintain overall services provided by wetlands by requiring developers to create or restore substitute wetlands	Ensuring that substituted wetlands are of equal value to those destroyed Ensuring equity for local populations who lose services	Wetland banking schemes in California allow developers who destroy wetlands to offset the environmental damage by paying to protect a sensitive wetland in another location (Office of Policy, Economics, and Innovation and Office of Water 2005).
Sector Policies			
Include ecosystem services in sector policies and strategic environmental assessments	Goes beyond addressing the impacts of economic development to look at dependence on services Broadens the scale of analysis	Dealing with the public sector's limited experience using an ecosystem services approach in decision processes, and limited information on ecosystem services	South Africa's Working for Water program combines the social development goals of job creation and poverty relief, the agricultural goal of increasing the productivity of cleared lands, and the ecosystem rehabilitation goals of eradicating alien species and restoring stream flows (Department of Water Affairs and Forestry 2007).
Set targets to encourage the use of renewable energy	Provides incentive to replace fossil fuels with renewable sources	Using land to produce renewable energy sources such as biofuels can lead to soil erosion and degradation of ecosystem services such as water quality	Under the U.K. Renewable Transport Fuel Obligation, transport fuel suppliers must ensure that a proportion of their fuel sales are from renewable sources, as of 2008 (U.K. House of Commons Environmental Audit Committee 2007).
Require ecosystem management best practices in granting licenses or concessions	Creates incentives for managing ecosystems in ways that sustain ecosystem services	Defining and enforcing best practice standards	Cameroon's 1996 Forest Code calls for all commercial logging to be regulated under designated forest concessions. This legislation establishes rules for concession allocation and local distribution of forest revenues, as well as requirements for submitting and gaining approval for forest management plans (World Resources Institute 2007).
Use zoning or easements to keep land available for priority ecosystem services	Provides a way to maintain priority ecosystem services	Requires a legal framework to be in place and a fair political process to apply zoning	Some flood plains are zoned for uses such as recreation or agriculture rather than housing or commerce. Easements can be used to keep land available for cultural and regulatory ecosystem services.

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Use physical structures or technology to substitute for ecosystem services	Provides a substitute for degraded ecosystem services that may mimic natural design	Building structures such as seawalls to substitute for ecosystem services such as coastal protection often simply shifts the problem, distributing costs and benefits unfairly, fostering false confidence, and providing only a single benefit rather than the multiple benefits of ecosystem services.	Seattle's street edge projects mimic natural ecosystems, reducing stormwater runoff by 99%. Roof gardens also reduce runoff (Seattle Public Utilities 2007). Dikes and levees substitute for coastal protection. Seawalls avoid coastal erosion.
Use regulatory ecosystem services such as natural hazard protection or water filtration instead of built structures	Usually provides co-benefits such as carbon storage and recreation	Procuring time and funds for negotiations and continued maintenance Dealing with limited knowledge about ecosystem service flows, especially for regulating and cultural ecosystem services	New York City protected its watershed instead of building a filtration plant (U.S. Environmental Protection Agency 2007). Reforestation and conservation of mangroves in coastal areas affected by the 2004 tsunami can help prevent future damage (United Nations Environment Program World Conservation Monitoring Center 2006). Sebago Lake: see Appendix 1
Establish certification schemes that encourage best management practices	Provides those growing or harvesting timber, fish, or crops a way to learn about best management practices and to demonstrate use of the practices	Ensuring development of transparent, scientifically valid standards and their adoption Paying transaction costs that may limit participation Informing consumers	The U.S. Department of Agriculture provides farms with organic certification (U.S. Department of Agriculture 2006). The Forest Stewardship Council provides certification for sustainable timber harvesting practices (U.S. Forest Stewardship Council 2006). In the Pacific U.S. states, "salmon-safe" certifies farms and urban lands that practice fish-friendly management (IUCN 2007).
Introduce education or extension programs on good practices	Provides knowledge to those maintaining ecosystem services	Providing economic incentives for participation	The U.S. National Conservation Buffer Initiative educates farmers to control pollution by using filter strips and other measures, such as wind barriers (USDA Natural Resources Conservation Service 2007).

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Develop and encourage the use of products and methods that reduce dependence and impact on ecosystem services	Reduces degradation of ecosystem services by avoiding harmful substances or using services more efficiently	Evaluating potential negative trade-offs, such as organic agriculture potentially requiring use of more land, which could lead to further habitat conversion	Drip irrigation in Israel allows for a more efficient use of water for agriculture (Sandler 2005). Rainwater harvesting practices increase the supply of drinking water in parts of India (Center for Science and Environment India 2004). Organic agriculture reduces negative impacts on soil and water by avoiding agrochemicals.
Governance			
Clarify or strengthen local community rights to use and manage ecosystem services	Ensures the involvement of stakeholders who may depend on ecosystem services for their immediate livelihood and well-being	Identifying who represents the community, clarifying the role of traditional authorities, ensuring that women and the poor are included	Vietnam's 1994 Land Law allows organizations, households, and individuals to manage forests for long-term purposes. Some 1 million families living in upland areas manage 5 million hectares of forest. As a result of this decentralization, protected forests have increased, as have the benefits the people gain from the forests' services (Food and Agriculture Organization of the United Nations 2000). Namibia conservancies: see Appendix 1
Develop and use private- and public-sector indicators for ecosystem services	Provides information about the state of ecosystem services and shows where practices need to be changed	Obtaining funding to develop ecosystem indicators and continued funding to disseminate and use data on a regular basis	The European Union makes indicators on natural resource management publicly available online (Eurostat 2006). The Silicon Valley Environmental Partnership provides indicators and tracks local trends to foster more informed decision-making (Silicon Valley Environmental Partnership 2007). The Global Reporting Initiative standards for corporate sustainability reports require the inclusion of company water and natural resource use (Global Reporting Initiative 2007).

Policy Option	Potential Value for Sustaining Ecosystem Services	Challenges in Design and Implementation	Examples of Experience
Establish processes to work across levels of government, from local to national	Shifts the focus to the boundaries of ecosystem services rather than the boundaries of government jurisdictions; uses complementary authorities, skills, and resources of different levels of government	Requires transaction costs and time for building partnerships	In Samoa, 40 local communities work with national agencies to co-manage fisheries. National government provides the legal authority, research, market information, credit, and transport. Local communities have clear rights and authority to manage the local fishery under a management plan (World Resources Institute et al. 2005).
Ensure public access to information and public participation	Allows the public to hold public and private actors accountable for their actions in relation to ecosystem services	Requires investment in building the capacity of individuals, civil society, and government to produce, analyze, disseminate, and use information and to engage effectively in decision-making	Evaluation of the Brazilian ecological tax system recommends making the amounts transferred public so local governments can be held accountable for their use (World Wildlife Fund 2003).

Except where noted, examples adapted from Millennium Ecosystem Assessment 2005, 11–21.

REFERENCES

Assey, P., et al. 2007. *Environment at the heart of Tanzania's development: Lessons from Tanzania's National Strategy for Growth and Reduction of Poverty (MKUKUTA).* Natural Resource Issues Series No. 6. London: International Institute for Environment and Development.

Bayon, R. 2002. Making money in environmental derivatives. *The Milken Institute Review,* Q1 2002.

Brand, D. 2005. *The combined challenge of forestry and terrestrial carbon management.* Pennant Hills, Australia: State of New South Wales.

Canadian Parks and Wilderness Society. 2007. *CPAWS federal action plan for nature conservation*

Central Point for Expertise on Timber. 2007. *UK Government Policy.*

Center for Science and Environment India. 2004. *Rainwater Harvesting.* http://www.rainwaterharvesting.org/index.htm.

Cochran, B., and B. Roll. 2008. *Proceedings of the Water Environment Federation*. WEFTEC Session 31 through Session 40:2697–2712(16).

Conservation Finance Alliance. 2003. *Belize: Protected Areas Conservation Trust (PACT)*. Switzerland: CFA.

Cooper, E., L. Burke, and N. Bood. 2009. *Belize's coastal capital: The economic contribution of Belize's coral reefs and mangroves.* WRI Working Paper. Washington, DC: World Resources Institute. http://www.wri.org/publication/coastal-capital-belize.

Department of Water Affairs and Forestry. 2007. *Working for Water program.* http://www.dwaf.gov.za/wfw/.

Eurostat. 2006. *Sustainable development indicators.* http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/indicators.

Ferraro, P. J., K. Lawlor, K. Mullan, and S. K. Pattanayak. 2011. Forest figures: Ecosystem services valuation and policy evaluation in developing countries. *Review of Environmental Economics and Policy* 6.1: 20–44.

Food and Agriculture Organization of the United Nations. 2002. *Land-water linkages in rural watersheds case study series: Water user associations in the Cauca Valley, Colombia.* Rome: FAO.

———. 2000. *Asia and the Pacific national forestry programs: Update 34.* Rome: FAO.

Garrity, D. P., F. K. Akinnifesi, O. C. Ajayi, S. G. Weldesemayat, J. G. Mowo, A. Kalinganire, M. Larwanou, and J. Bayala. 2010. *Evergreen agriculture: a robust approach to sustainable food security in Africa. Food Security* 2:197–214.

Global Reporting Initiative (GRI). 2007. *Global reporting initiative.* https://www.globalreporting.org.

Hackl, J., and T. Rohrich. 2001. *Landscape protection and buffer zones as part of nature conservation in Austria and their importance for forests.* Helsinki: WWF.

Hanson, C., J. Ranganathan, C. Iceland, and J. Finisdore. 2008. *The corporate ecosystem services review.* Washington, DC: World Resources Institute.

Hertsgaard, M. 2011 January 28. The great green wall: African farmers beat back drought and climate change with trees. *Scientific American* (excerpted from *Hot: Living Through the Next 50 Years on Earth, by M. Hertsgaard*).

International Finance Corporation. 2012. *Performance standards and guidance notes: 2012 edition.* http://www1.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/IFC+Sustainability/Sustainability+Framework/Sustainability+Framework+-+2012/Performance+Standards+and+Guidance+Notes+2012/.

Irwin, F., and J. Ranganathan. 2007. *Restoring nature's capital: An action agenda to sustain ecosystem services.* Washington, DC: World Resources Institute.

IUCN. 2007. *Pay: Establishing payments for watershed services.* Gland, Switzerland: IUCN.

Landell-Mills, N., and I. T. Porras. 2002. *Silver bullet or fools' gold? A global review of markets for forest environmental services and their impact on the poor.* London: International Institute for Environment and Development. http://www.iied.org/pubs/pdf/full/9066IIED.pdf.

Long, S., ed. 2004. *Livelihoods and CBNRM in Namibia: The findings of the WILD project.* Windhoek: Wildlife Integration for Livelihood Diversification Project, Ministry of Environment and Tourism, Namibia.

Millennium Ecosystem Assessment. 2005. *Ecosystems and human well-being: Policy responses*.. Washington DC: Island Press.

Myers, N. 1998. Lifting the veil on perverse subsidies. *Nature* 392:327–328.

Office of Policy, Economics, and Innovation and Office of Water. 2005. *Applying lessons learned from wetlands mitigation banking to water quality trading.* Washington DC: U.S. Environmental Protection Agency.

Parliament of Australia, Senate Committee. 2006. *Water policy initiatives.* Canberra: Government of Australia.

Perrot-Maître, D., and P. Davis. 2001. *Case studies of markets and innovative financial mechanisms for water services from forests.* Washington DC: Forest Trends.

Porras, I., and N. Neves. 2006. *Markets for watershed services country profile: Ecuador — FONAG.* International Institute for Environment and Development. http://www.watershedmarkets.org/documents/Ecuador_FONAG_E.pdf.

Powicki, C. R. 2002. Eco-solutions plays key role in landmark conservation deal. *EPRI Journal Online.*

Ranganathan, J., K. Bennett, C. Raudsepp-Hearne, N. Lucas, F. Irwin, M. Zurek, N. Ash, and P. West. 2008. *Ecosystem services: A guide for decision makers*. Washington, DC : World Resources Institute. http://www.wri.org/publication/ecosystem-services-a-guide-for-decision-makers.

Ranganathan, J., and C. Hanson. 2011. A new approach to feeding the world. *Solutions* 2(5):26–30. http://www.thesolutionsjournal.com/node/977.

Reij, C. 2008. Human geographer, Center for International Cooperation, VU University Amsterdam. Personal communication.

Rickets, T. H., G. C. Daily, P. R. Ehrlich, and C. D. Michener. 2004. Economic value of tropical forest to coffee production. *Proceedings of the National Academy of Sciences* 101(34):12579–12582.

Sandler, N. 2005 December 30. Israel: Waterworks for the world? *BusinessWeek*. http://www.businessweek.com/technology/content/dec2005/tc20051230_495029.htm.

Sathirathai, S., and E. B. Barbier. 2001. Valuing mangrove conservation in southern Thailand. *Contemporary Economic Policy* 19(2):109–22.

Seattle Public Utilities. 2007. *Street Edge Alternatives (SEA Streets) project.* http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/GreenStormwaterInfrastructure/NaturalDrainageProjects/StreetEdgeAlternatives/.

Silicon Valley Environmental Partnership. 2007. *The partnership.* http://www.svep.org.

Stevenson, N. J. 1997. Disused shrimp ponds: Options for redevelopment of mangroves. *Coastal Management* 25(4):425–435.

Tappan, G. 2007 July 12. RE: Extent of natural regeneration in Niger." FRAME website discussion post. Washington, DC: FRAME Community, United States Agency for International Development.

Turner, R. K., D. Burgess, D. Hadley, E. Coombes, and N. Jackson. 2007. A cost–benefit appraisal of coastal managed realignment policy. *Global Environmental Change* 17:397–407.

U.K. House of Commons Environmental Audit Committee. 2007. Government response to the Committee's first report of session 2006-07: The UN Millennium Ecosystem Assessment. *Sixth Special Report of Session 2006-07*. http://www.publications.parliament.uk/pa/cm200607/cmselect/cmenvaud/cmenvaud.htm.

United Nations Environment Program World Conservation Monitoring Center. 2006. *In the front line: Shoreline protection and other ecosystem services from mangroves and coral reefs.* Cambridge, UK: UNEP-WCMC. http://www.unep.org/pdf/infrontline_06.pdf.

U.S. Department of Agriculture. 2006. *Agriculture: Organic certification.* http://www.usda.gov/wps/portal/!ut/p/_s.7_0_A/7_0_1OB?navid=ORGANIC_CERTIFICATIO&navtype=RT&parentnav=AGRICULTURE.

U.S. Department of Agriculture: Natural Resources Conservation Service. 2007. *Buffer strips: Common sense conservation.*

U.S. Environmental Protection Agency. 2007. *New York City watershed agreement.* http://www.epa.gov/owow/watershed/ny/nycityfi.html.

U.S. Forest Stewardship Council. 2006. *The Forest Stewardship Council.* http://www.fscus.org/about_us/.

United States House. 2006. *The Pension Protection Act of 2006.* 109th Cong., 2nd sess., H.R. 4.

Weaver, C., World Wildlife Fund/Namibia. 2011 May. Personal communication.

Whelan, C. 2010. Liquid asset. *The Nature Conservancy*. 60(3):42–49.

World Resources Institute. 2007. *Interactive forestry atlas of Cameroon*. Washington, DC: World Resources Institute.

World Resources Institute, United Nations Development Program, United Nations Environment Program, and the World Bank. 2008. *World resources 2008: Roots of resilience: Growing the wealth of the poor*. Washington, DC: World Resources Institute. www.wri.org/publication/world-resources-2008-roots-of-resilience.

———. 2005. *World resources 2005: The wealth of the poor: Managing ecosystems to fight poverty*. Washington, DC: World Resources Institute.

———. 2000. *People and ecosystems: The fraying web of life*. Washington, DC: World Resources Institute.

World Wildlife Fund. 2003 July 2. Brazilian government reveals alarming rate of deforestation in Amazon: World Wildlife Fund responding to forest threats. World Wildlife Fund press release. http://www.worldwildlife.org/who/media/press/2003/WWFPresitem631.html..

World Wildlife Fund and Rossing Foundation. 2004. *Living in a Finite Environment (LIFE) project: End of project report for phase 11: August 12, 1999–September 30, 2004*. Washington, DC: United States Agency for International Development.

World Vision Australia. 2010. *Farmer managed natural regeneration (FMNR): A good news story for a deforested and degraded world.* Video. http://www.youtube.com/watch?v=E9DpptI4QGY.

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Seminar

7

Forecasting and What's Next for Ecosystem Services

Speaker
Janet Ranganathan

2011 ECOSYSTEM SERVICES SEMINAR SERIES

GORDON AND BETTY MOORE FOUNDATION

Ecosystem Services Seminar 7: Forecasting and What's Next for Ecosystem Services

Presentation and Discussion Notes From Speaker: Janet Ranganathan

Seminar Series and Seminar 7 Goals:

The goal of the multi-session seminar is to educate the broader conservation community including practitioners and funders on the diverse aspects of ecosystem services – such as how to account for ecosystem services and to effectively measure, manage, and communicate them.

Seminar 7 and associated readings focused on the following goals:

- *Key lessons from the seminar series*
- *Forecast of promising ecosystem services opportunities*
- *Identification of key challenges*
- *Outline of next steps for ecosystem services implementation*

Disclaimer:

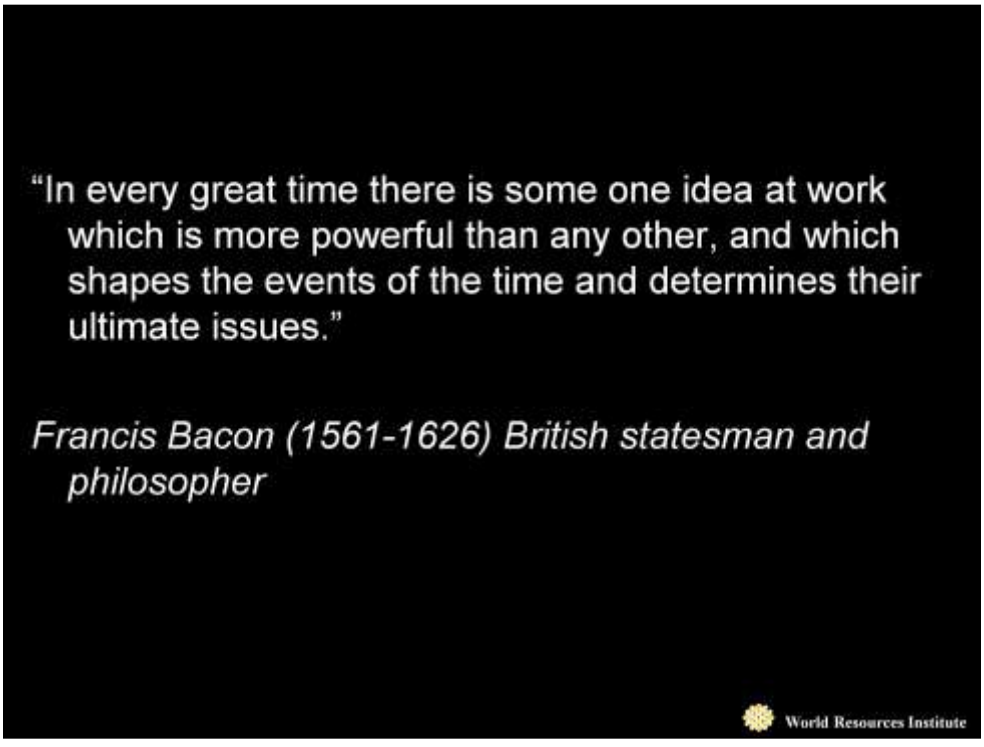
This document is a summary that includes PowerPoint slides from the speaker, Ms. Janet Ranganathan and notes of her talking points. Please keep in the mind that the following document is only a recap of the presentations and Blue Earth Consultants' notetakers have, to the best of their ability, captured the presentations. We hope that the following presentations and discussion notes will be used as resource to advance further discussions about ecosystem services.

GORDON AND BETTY MOORE FOUNDATION

COASTAL QUEST

BLUE EARTH CONSULTANTS

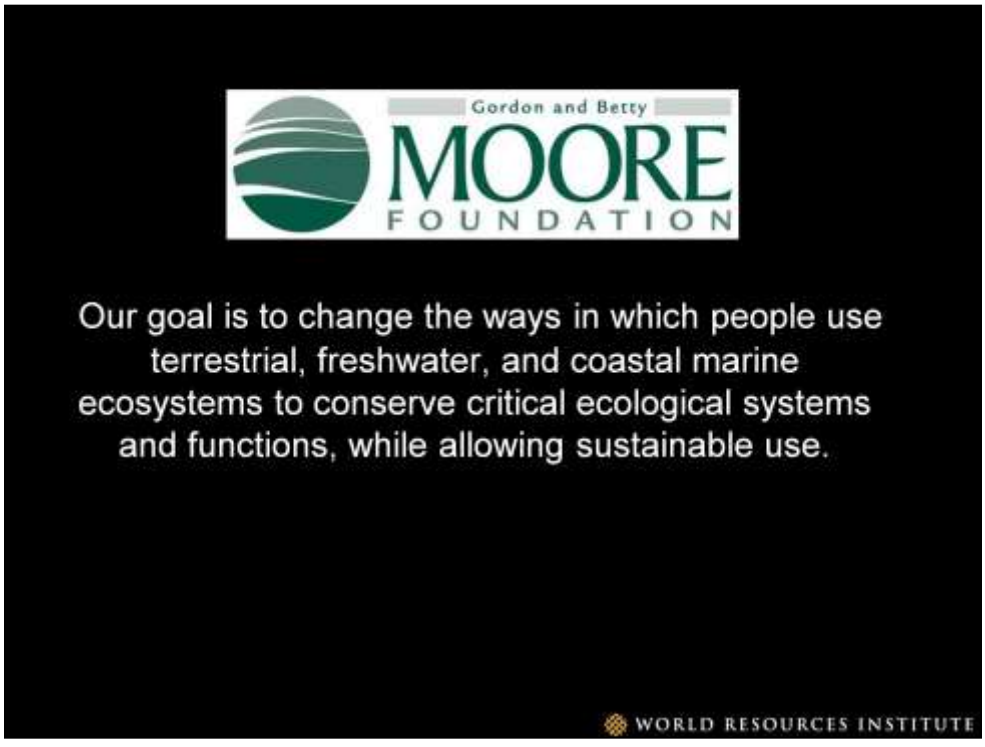
- Today's presentation will have a panel, but that panel will be all of you. This is the seventh and final session and I want you to think of it as the culmination of how ecosystem services (ES) can help you reach your conservation outcomes.
- We are not close to winning the war on reversing environmental degradation. We need to think radically about our approach, especially in a world of seven billion people. We need to be creative and using ES as a strategy can be a way for us to do that.



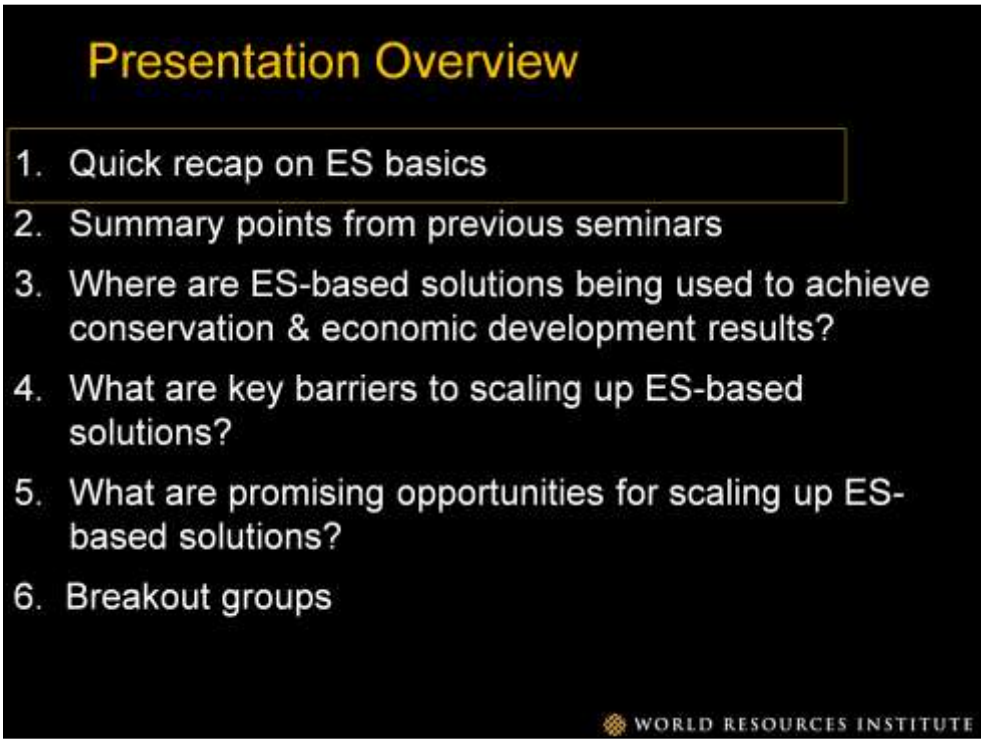
- How do we feed nine billion people ?
- How do we sustain the environment given the demand?

- I personally feel like ES may be a way to do that, but you will come to your own decisions.

- Here is a little bit of information about the World Resources Institute (WRI).
- The slide shows WRI's mission statement and I want to highlight the word "move." WRI is not just a think tank, we are about action.

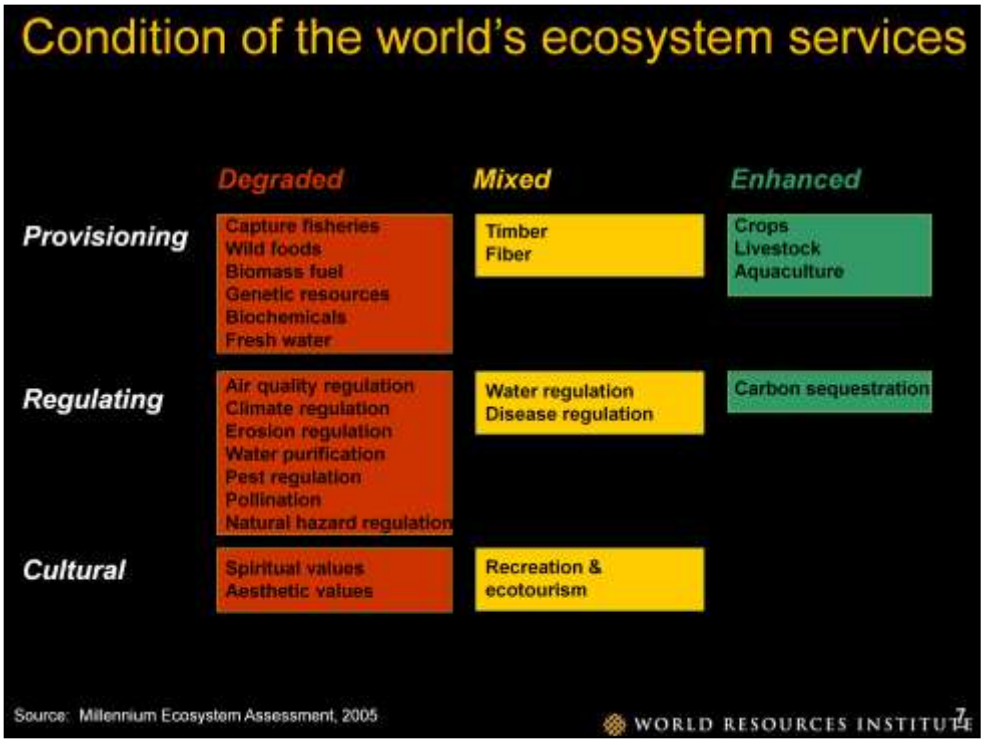


- Here is the Gordon and Betty Moore Foundation's (GBMF) mission statement. Notice that it has people in it!
- WRI and GBMF are not very different. WRI found ES very compelling to advance its own mission; ES is the bridge between people and systems.

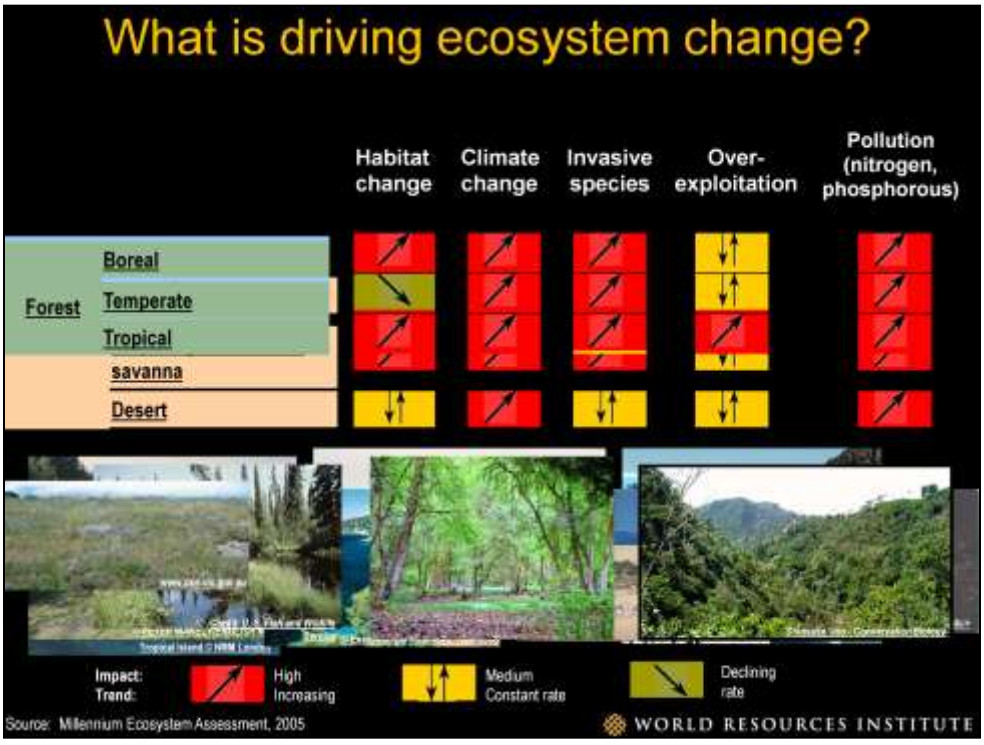


- Here is an outline of today's presentation.
- I will give you 12 examples of where ES-based solutions are being used, but I think there are many more ways to think about ES. My goal is to give you a lot to encourage you to think about it more.

- The Millennium Ecosystem Assessment (MA) was a global audit of the world's forests, wetlands, and other ecosystems, completed in 2005. It was commissioned by the United Nations and involved more than 1000 scientists worldwide. The MA assessed the condition of ecosystems in terms of ecosystem services, or the benefits ecosystems provide to humans. The MA codified four categories of ecosystem services: provisioning, regulating, cultural, and supporting.
- There are three types of ES: provisioning, regulation and cultural.
- Provisioning services are goods we receive from ecosystems. They include freshwater, food, and timber.
- Regulating services are benefits obtained from control of natural processes, including pollination, natural hazard protection, and air quality regulation.
- Cultural services are non-material benefits we receive from ecosystems such as recreation, ecotourism, existence value, and cultural identity.



- The Millennium Ecosystem Assessment found that about two thirds of the 24 ecosystem services assessed globally are degraded. This degradation will likely grow significantly worse in the first half of the 21st century.
- Thanks to the MA, we know that 15/24 ES are degraded, and only 4 have been enhanced.
- This is like a dashboard for ecosystems and if you were the manager, you might be in a panic. It depicts the problem, but it is also shows the opportunity; the scarcity issue is kicking in. Before, we could drain thousands of acres of wetland, but not we know there are limits.



- Now let us talk about the five drivers of ES change.
- If conservation strategies are not addressing drivers in your region, it will not be successful and the degradation will move somewhere else.

- Maximizing one service at the expense of others is common.
- Take the Chesapeake Watershed as an example. It is dying because there is a hypoxic zone from all of the waste from the upstream chicken farms and corn agriculture. We are optimizing agricultural productivity while water quality is declining.
- Another example about tradeoffs comes from Brazil. In Brazil, they are optimizing soya bean at the expense of many natural services.
- Models are determining at which point degradation reaches a tipping point. These models are looking at what percentage of deforestation will eliminate water regulation of the Amazon. If the great water pump shuts down, it would be detrimental to agriculture.

    - Who will benefit?
    - Certainly those who are driving the change?
    - Who pays the cost?

- Typically, it is the large agricultural companies that benefit (those driving change) while the poor bear the costs.

- Making the economic case for conservation is more than just making monetary investments. Other areas to invest include:
    - Policies;
    - Knowledge management;
    - Adjusting business strategies; and
    - Development policies.
- Today we will talk about ES solutions and how we can make investments to work on this.

Group Responses:

Participant

- I think there has been too much emphasis on making the case; a lot of organizations are busy making the case for pollination, watershed management, but there seems to be a need for making the link between people and community development. It comes down to the whole system. When you think about watersheds, what happens upstream is important, but downstream distribution among the cities is also important: infrastructure, etc. We need to address the whole system to be successful, which means we will have to put money into better managing watersheds and fixing the piping system. Policy makers are focused on more than just what conservationists think about and we need to fit into that thinking.

Participant

- Can you elaborate on what you think economic development benefits are?

Janet Ranganathan

- In my mind, it is wherever you are benefiting humans. Poverty reduction strategies can focus on the people side even though it is a conservation concept. Some economic development sectors have a more intimate link than others. In business, you can usually find the link in how products are made and used.

Participant

- How do you think about the spectrum of ES? For example, there are things that nature provides that have prices and markets; they have finite numbers. Some services nature does not renew over long periods of time, others renew quickly.

    - What services are in and what are out?

Janet Ranganathan

- I think very about the narrow MA ES definition. Services are those that we derive from nature. For instance, fossil fuel is a ES of millions of years ago.

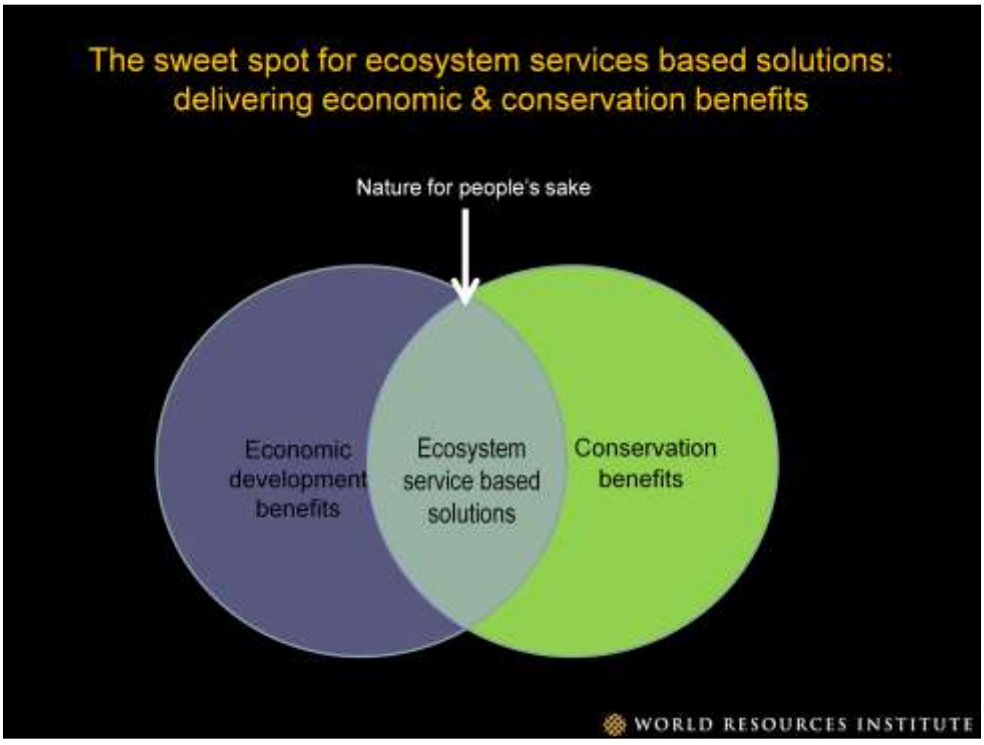
Participant

- I tend to think more about productivity of natural capital.

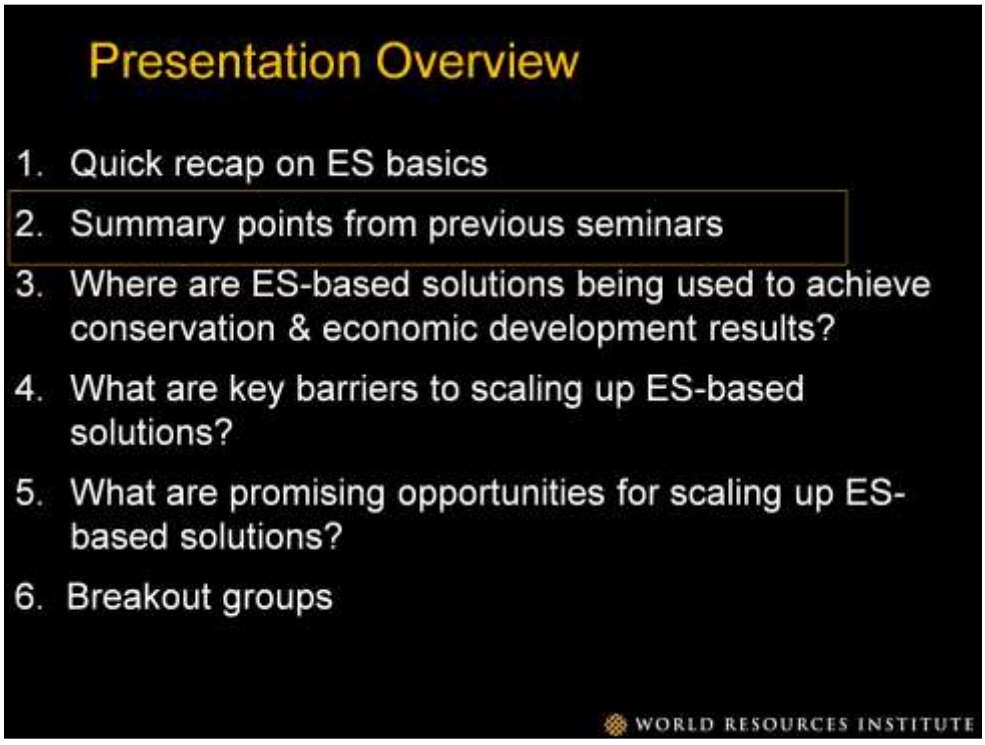
Participant

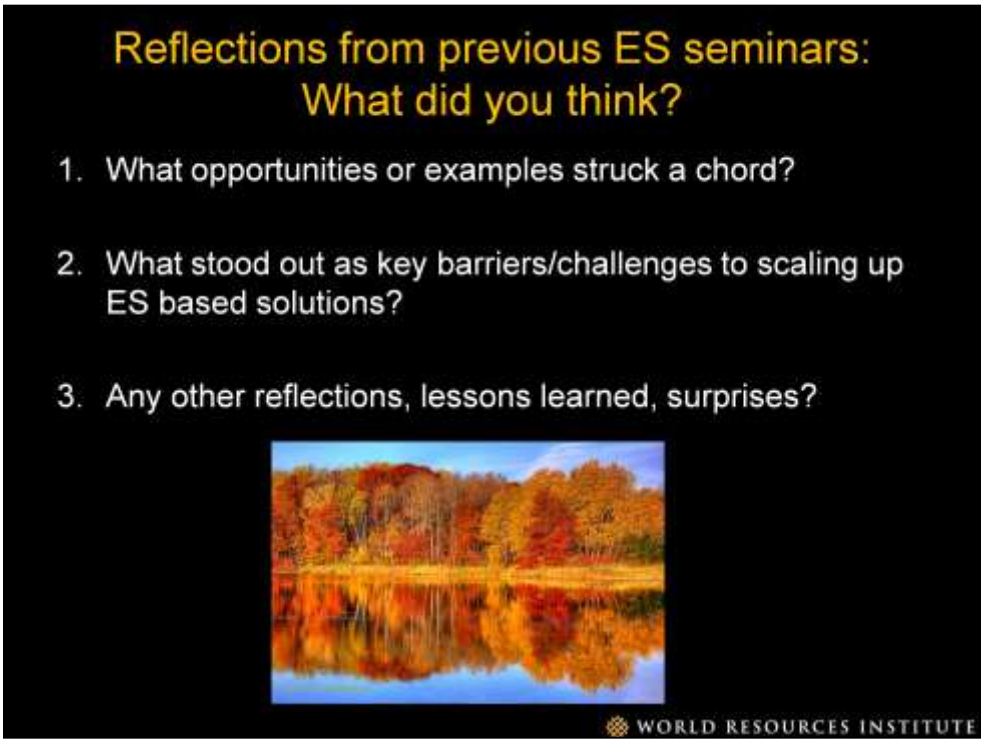
- When working with indigenous communities, cultural services are those that are most important. We do not always have to use the term ES, just something that fits and works with the audience.

- The ES approach is not a replacement for the biodiversity approach. Even this seminar frames it as the next wave, but it should not be one wave or the other. The concepts need to work together and reinforce one another.



- I think the sweet spot in this is making the case of nature for people's sake.
- I advocate that solutions go straight down the center.
- When I was in college I thought about nature as separate from people and how development threatened nature. Now I think the opposite; development is threatened by nature.
- Our generation is going to be known for the most intense and extreme degradation yet.


Presentation Overview
1. Quick recap on ES basics
2. Summary points from previous seminars
3. Where are ES-based solutions being used to achieve conservation & economic development results?
4. What are key barriers to scaling up ES-based solutions?
5. What are promising opportunities for scaling up ES-based solutions?
6. Breakout groups
WORLD RESOURCES INSTITUTE



Group Responses:

Opportunities

- Science will improve with demand.
- Disasters and crises; they get people thinking and can be transformative.

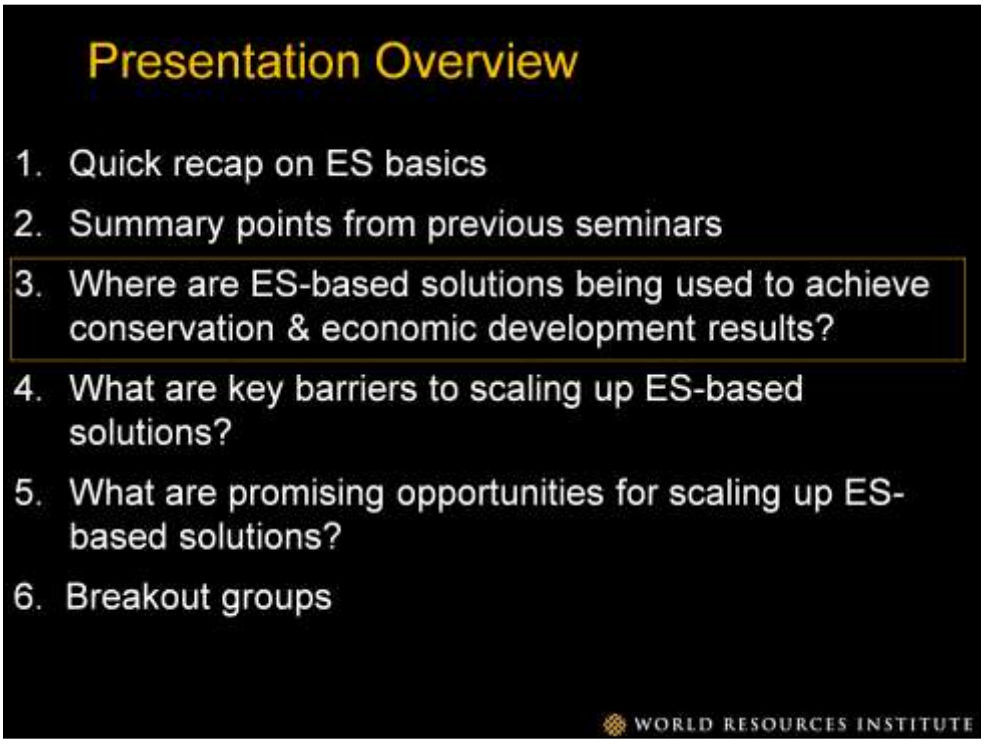
Barriers

- Multiple scales and multiple ecosystems.
- The many equity issues and determining who benefits and who does not.
- Institutionality that overlaps within the system.
- Science limitations - How much science do we have?
- Competition with alternative methods and tools.
- Redefining legal/contractual ownership.
- Lack of a common language.
- Developing/using generic tools that need to be fine-tuned and require additional modeling while still remaining transferable.

Reflections/Lessons Learned

- We should grapple with multiple ecosystems.
- Work for a proactive approach that is complimentary to current tools.
- Important to manage the context of risk.
- Need to understand that ES is a method for managing tradeoffs.

- Tools that will be used to inform decision-making, need to be agnostic.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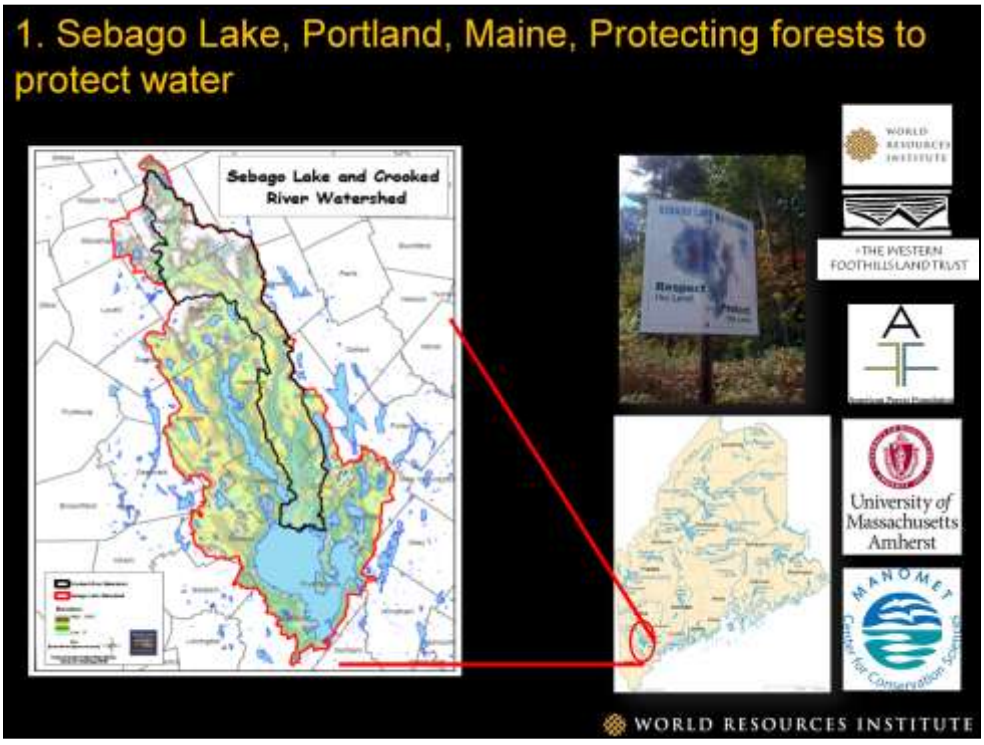
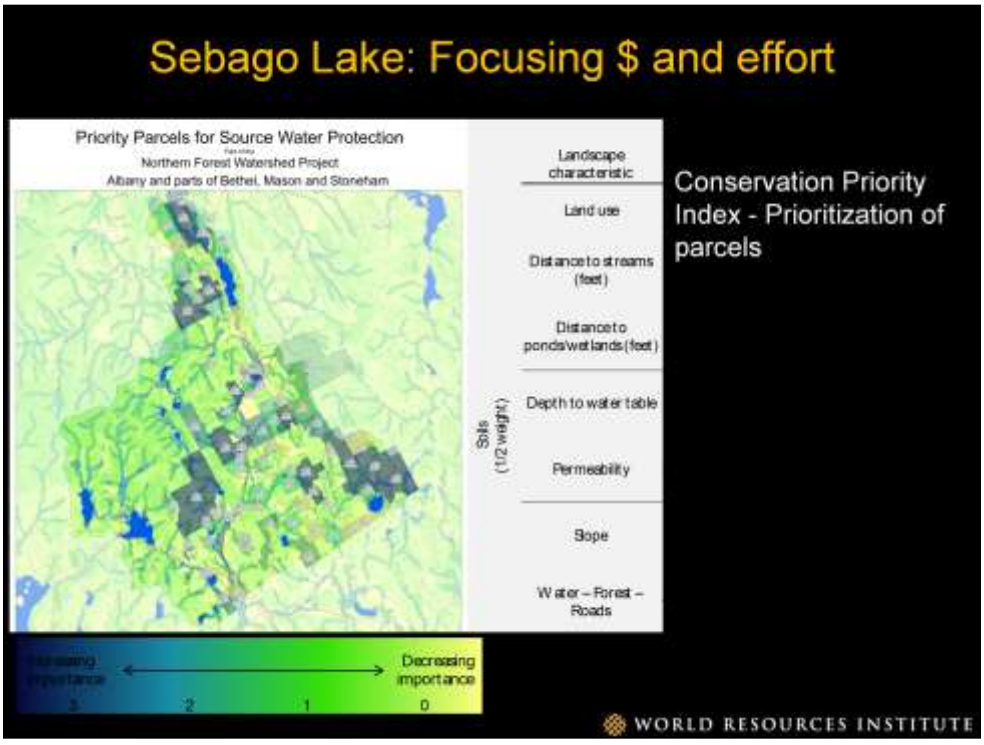
ES-based solutions
12 examples from the field
WORLD RESOURCES INSTITUTE
17



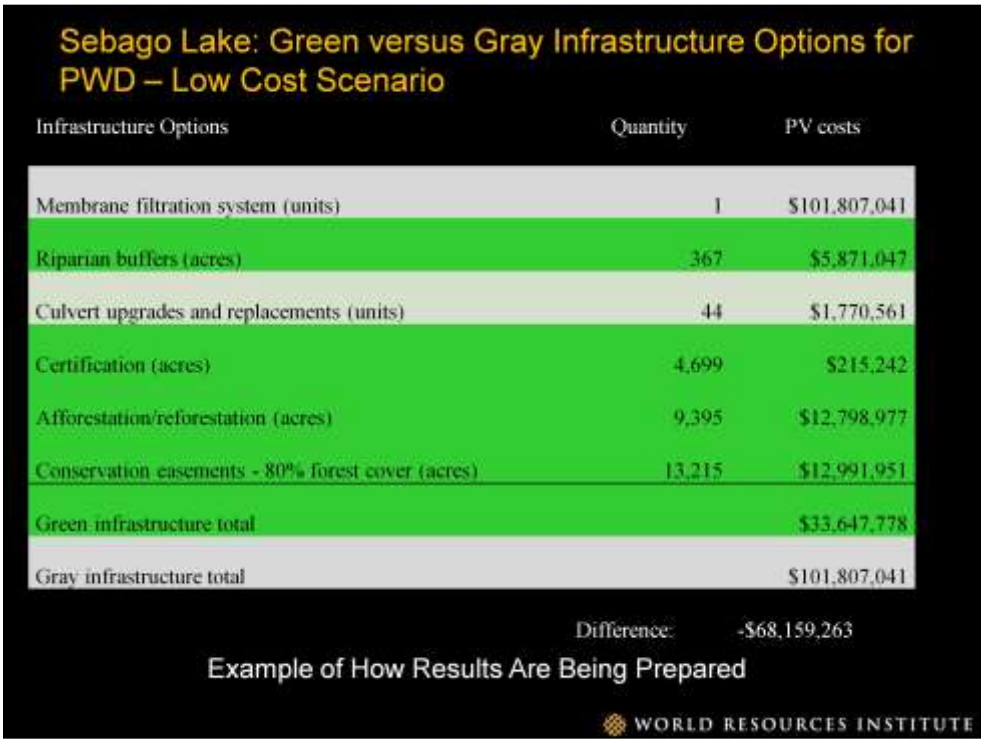
- Here is the first example of something WRI and its partners have been involved in.
- Two thirds of US forests are privately owned. Many of these owners are reaching retirement age and there is a wonder about the transfer of ownership.

  - During this transfer, how do we keep the forest a forest?

- WRI did an analysis of 20 northern states using an ES approach around water, downstream population, concentration of private ownership, and future development problems.
- From this analysis, we identified Sebago Lake as the ideal location to protect forest as it supports the population in Portland, Maine.

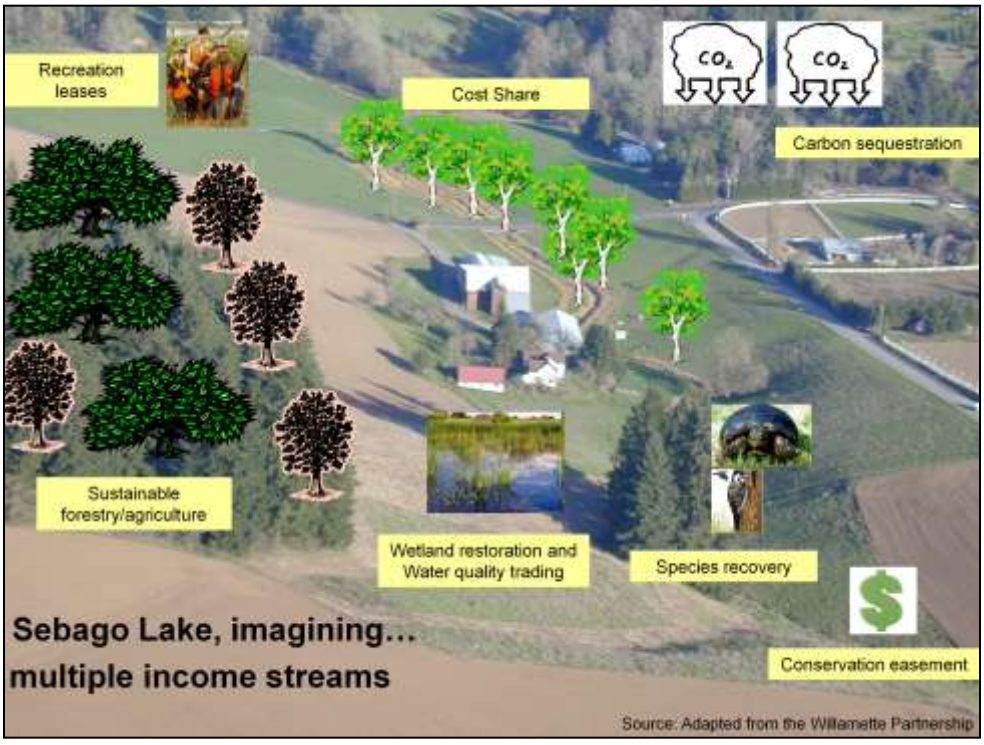


- We then sought to determine how to best target a fund to support this protection knowing that not all land provides the same ES.
- There are other variables as well, like slope, proximity to watershed, etc.
- It is important to select pockets of land for investment.

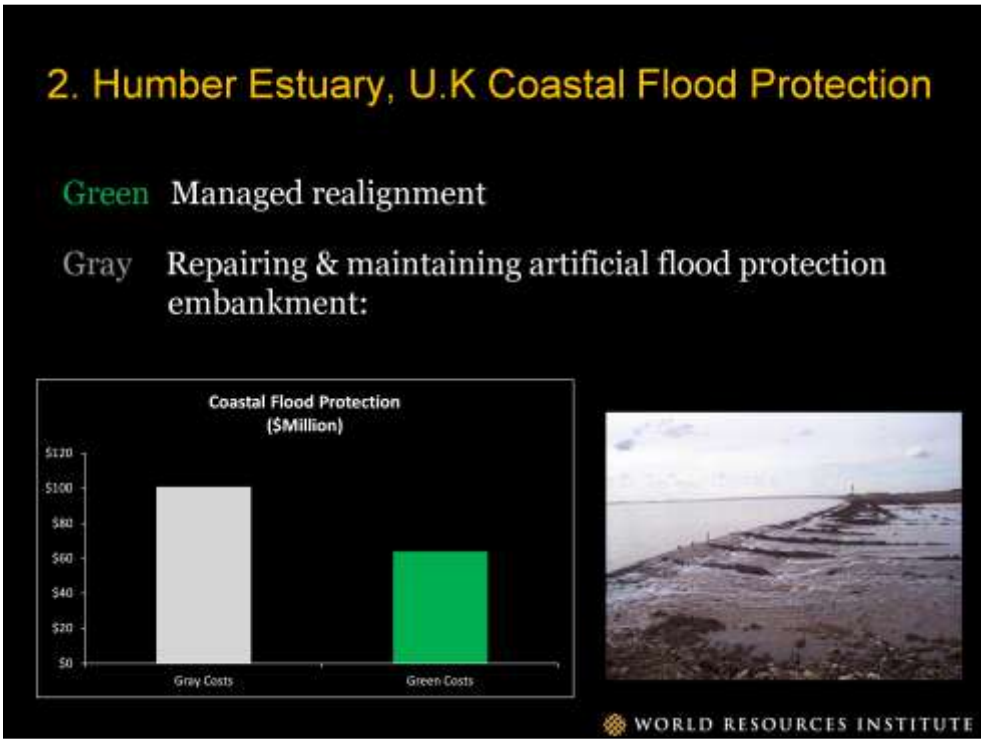


- We then did a cost-benefit analysis to see what it would cost to invest in being green.
- Portland, Maine has a filtration waiver, because it is assumed that the watershed is good enough to purify the water. But in the future, that could be removed so we looked at the cost of losing it.
- I think there is a real need to standardize this process when it comes to water.
- The green choice represents a lower cost, but it is one you have to pay upfront. The gray choice is eventually more expensive, but you pay later on down the road.

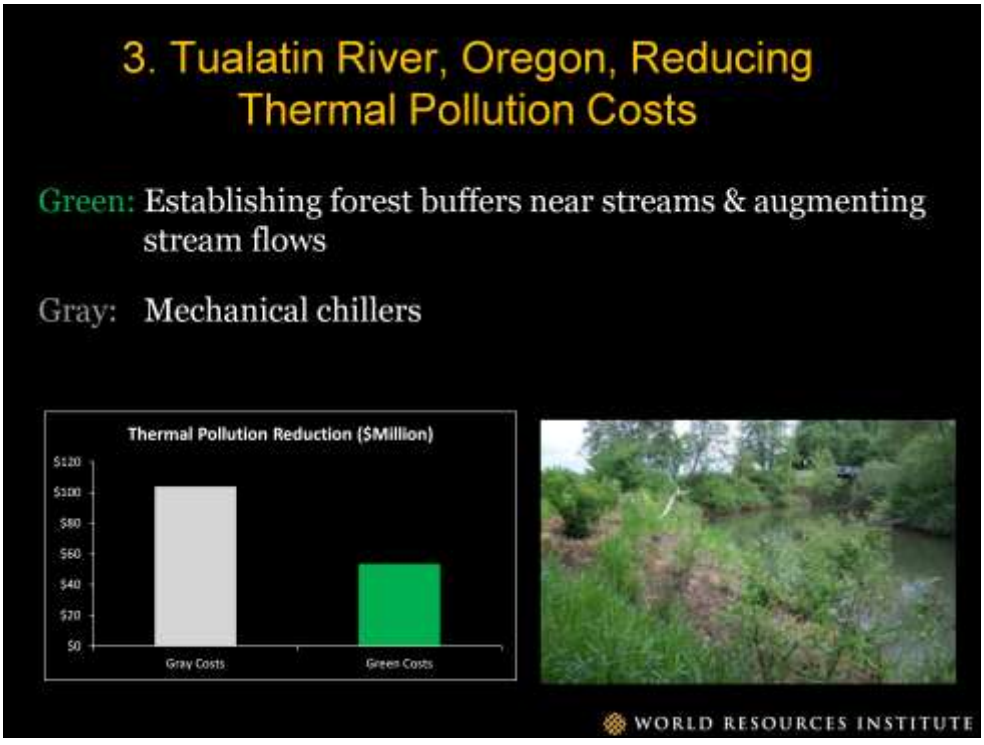
  - How do you get people to make the green choice?
  - Do you put it on a ballot?



- We are not going to make progress paying for one service. Progress will come from stacking ES. That way you can share the costs. Here you can bring in the United States Department of Agriculture (USDA) to help with cost sharing. Conservation easements can be another way to do this. There are lots of services and many ways to partner and package them together; it is still a work in progress.
- We are trying to go through it systematically to make this replicable and transferable to other locations.
- It is not compelling for WRI to tell a community that they need to invest in green infrastructure, but it is if the water company says they need to. The water company is in the business of development and they are more credible.



- Many of the flood defense structures along the English coastline are reaching the end of their design lives, and given concerns about sea level rise and increasing severity and frequency of storms on these structures, planners are considering alternative options, namely, managed realignment.
- Managed realignment involves the repositioning of an existing hard sea defense to a more landward location, thereby allowing more space for the creation of intertidal habitat. The study found that in several scenarios, managed realignment can be more economically efficient than holding the line over a period of 25 years. The authors estimated that for a scenario, greater emphasis is placed on habitat creation, the gray infrastructure option could cost up to $101 million while the green option would cost only $64 million.

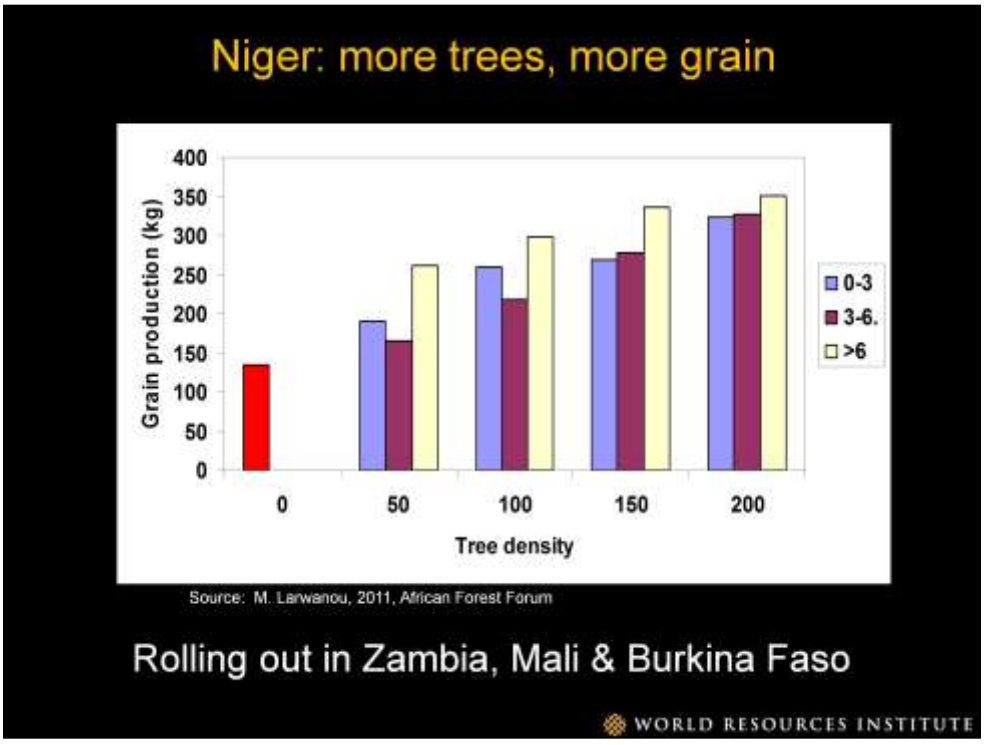


- Under the temperature total maximum daily load (TMDL) for Oregon's Tualatin River, Clean Water Services (CWS), a wastewater and storm water utility, faced the prospect of installing and operating a chiller at a twenty-year cost of approximately $104-255 million to reduce its thermal load.
- To lessen its costs, CWS developed an alternative plan to establish riparian forests that provide shade to water upstream of the wastewater facilities and to augment stream flows with releases of water from upstream reservoir. Establishing streamside forest will reduce its costs by about $50.5 million. In 2004, the Oregon Department of Environmental Quality (DEQ) approved this plan, the first of its kind in the U.S.
- The tree planting strategy has been tested on a large scale in the Tualatin River watershed in the Portland area. Cities along the river and CWS, a public utility, have planted more than half of a million native trees and shrubs since 2005. The project's "Tree for All" Community Tree Planting Challenge has involved volunteers, schools, nonprofits, and community groups.
- There is at least one other community trying to do this.

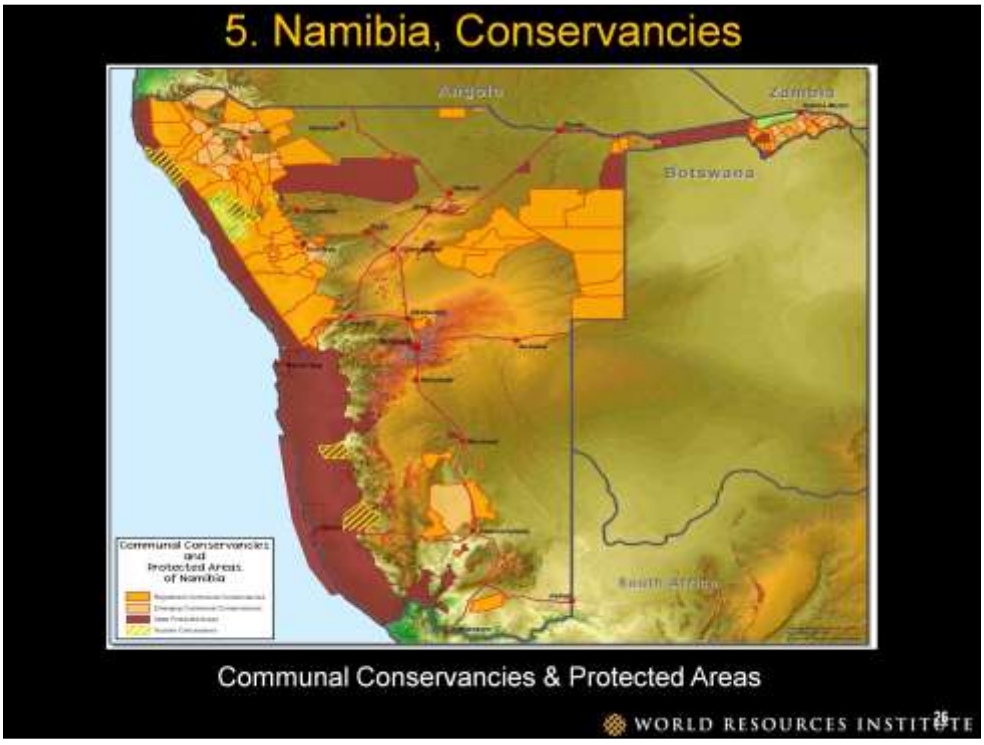
- Farmers have changed practices for clearing and cultivating fields and for managing trees and shrubs. The changes in practice have regenerated over 1.3 million trees per year in Maradi region alone.
- Niger was headed to desertification because of bad agricultural practices. When French colonists came to Niger, they changed agriculture practices to those less suited for the climate. They seperated the crop growth and did not appreciate the role of each one separately and collectively.
- In the 1980's, efforts began to regenerate trees. There was a unlikely champion, a missionary (Tony Renaldo), who worked with international agencies. Now the average farmer earns up to three times as much and they spend less time acquiring firewood.

    - What did it take to make this happen?
    - How can we replicate it?

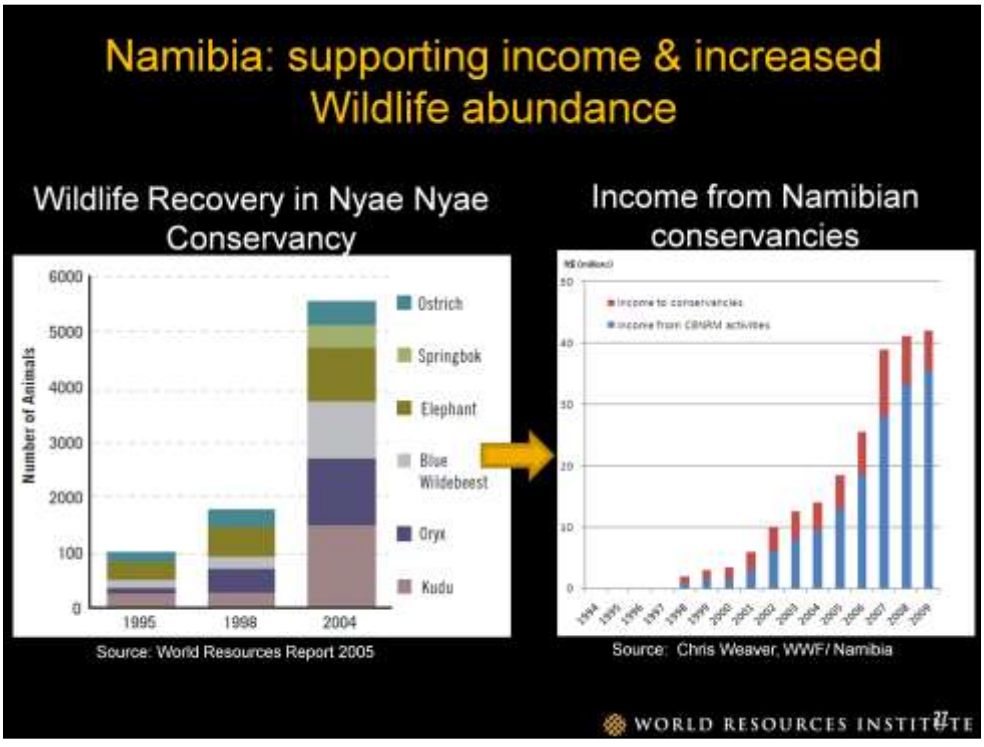
- When the French left Niger, the government kept ownership of the trees and fined people for doing anything to them. The government changed the law and gave farmer's the right to their own trees.
- To make this cost effective, they tried many different options to regenerate trees. They developed a methodology to regenerate trees from the underground stumps that remained. The trees were already adapted and could prosper in area, they just needed to get the chance to grow again.
- The success of this program spread from farmer to farmer; there was no development agency telling them what to do, it was their neighbor's advice.



- Farmer managed regeneration in Niger has led to better conservation and land management practices and improved livelihoods in Niger.
- If you conserve soil and water, there will be more trees in fields, and more grain produced.
- Trees produce multiple benefits including:
    - Products and income from wood;
    - Edible leaves and fruit;
    - Fodder, pods, and bark;
    - Nitrogen fixation in soils;
    - Carbon fixing in soils;
    - Controlling erosion; and
    - Improving micro-climate.
- The big message is that you do not have to wait seven years to see benefits, you start to see them in the first three years.



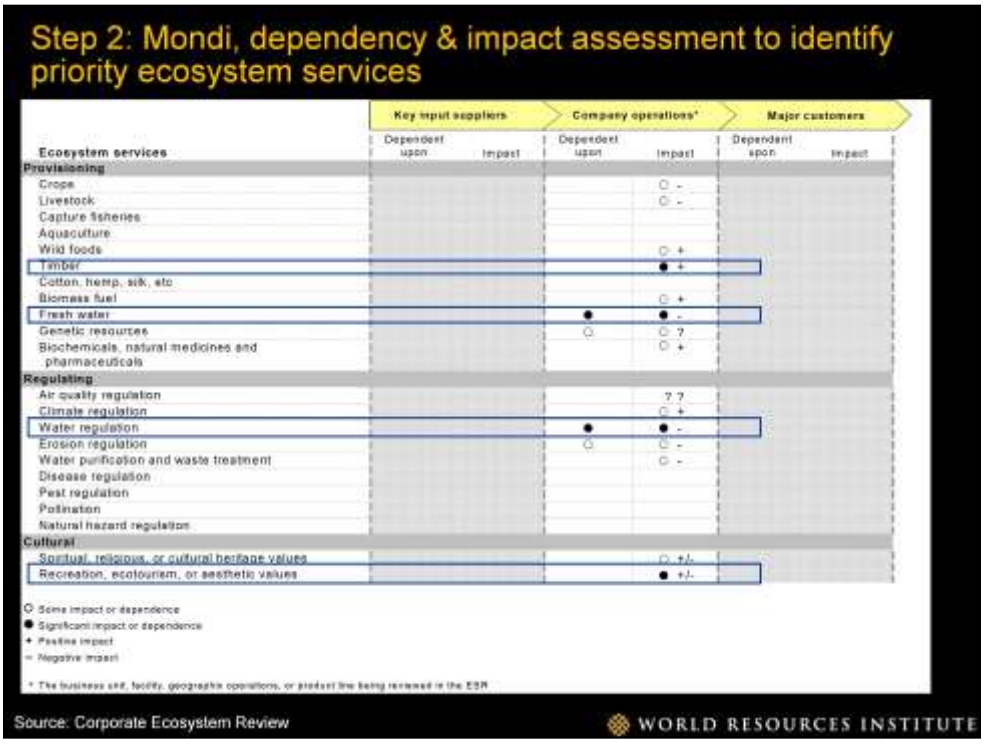
- From a modest start in the early 1990's with the adoption of progressive legislation granting local communities the right to benefit from wildlife, the Conservancy program has steadily expanded its geographic coverage to include more than 14 million hectares in 64 registered Conservancies, covering 17.6% of the country and involving 240,000 people or 12% of the population of Namibia.
- 31 of the Conservancies are immediately adjacent to national parks or key corridors between these parks, so the Conservancies have enhanced the viability of the protected area network by reduced poaching and promoting more compatible land use adjacent to the parks.
- Community-based natural resource management (CBNRM) empowered local people with user rights to wildlife (but not ownership rights).
- Changed management of wildlife - local community members set up conservancy committee to manage wildlife on their lands.
- There was strong support from both public and private sector. NGOs were dedicated to supporting conservancy committees.
- Previously, wild predators imposed significant costs on rural herding communities. With the introduction of CBNRM, local people could –for the first time – benefit from wildlife living on their communal lands.



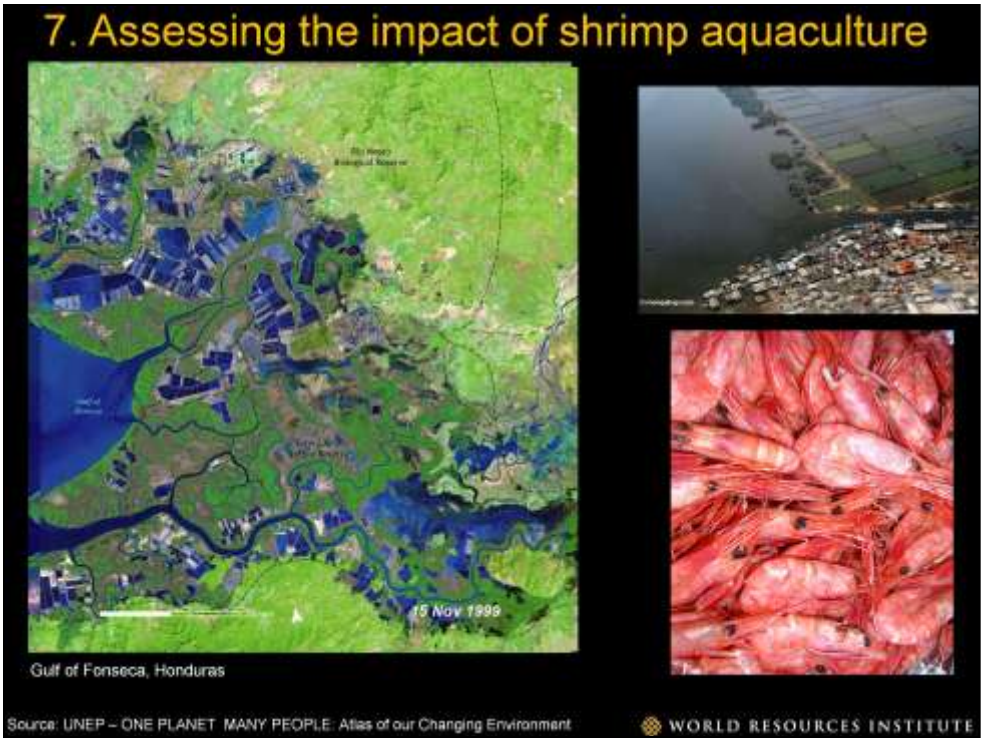
- As Namibia's Conservancy movement has spread and gained momentum across the country, landscape connectivity has occurred enabling an expansion of protected, monitored, and managed habitats for more effective conservation of a wide range of wildlife species, including lion, cheetah, leopard and hyena.
- As of May, 2011, the Conservancy program in Namibia had generated over N$241 million or $28 million in cumulative economic benefits since the program was launched in the mid-1990's.
- Direct benefits for community participants in 2009 amounted to N$42.48 million or US$5.05 million.
- Biggest contributor is joint venture tourism (57%), followed by hunting concessions (34.3%). Other income is earned from campsites, community-based tourism enterprises and crafts (6.1%); natural plant products (1.7%) and live game sales (0.8%).
- Other community benefits include community empowerment, particularly women empowerment.
- This example displays how you can get conservation and community benefits.

- *The Corporate Ecosystem Services Review* (ESR) is a structured methodology that helps managers proactively develop strategies to manage business risks and opportunities arising from a company's dependence and impact on ecosystems.
- This provides a methodology for companies to assess risk and has been used by a lot of companies.
- ALCOA examined its impacts in Canada and is now investing in ES as a result.
- In many ways, I think this did a better job getting ES on the business agenda than government has.

- There are five steps to the ESR.
- Important to realize that you do not have to do it for the whole company, just do it for where it is relevant.

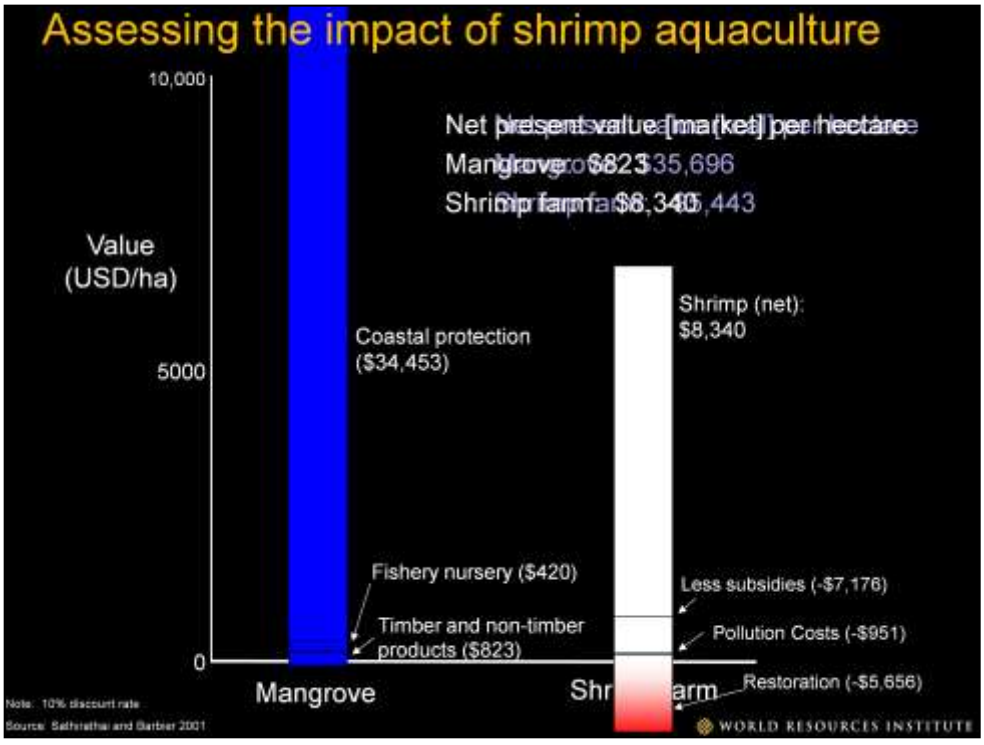


- Mondi looked at plantations in South Africa and realized that they did not need to deal with it all, just need to deal with the most important.
- The ESR helped to highlight how freshwater is important for Mondi, but also showed how they are having a negative impact on it.
- In this case, they used the clearing to produce biomass.



- Who likes shrimp? Do you know where it comes from?

- Nearly 35% of mangroves have been lost between 1980 – 2000.
- Honduras is second only to Ecuador in the production and exportation of cultured shrimp from Latin America. Shrimp farmers are depriving fishers, farmers, and others of access to mangroves, estuaries and seasonal lagoons; destroying mangrove ecosystems, altering the hydrology of the region, destroying the habitats of other flora and fauna and precipitating declines in biodiversity; contributing to degraded water quality; and exacerbating the decline in Gulf of Fonseca fisheries through the indiscriminate capture of other species caught with the shrimp post larvae that are used to stock ponds. There are both national and international enterprises in the region.
- Similarly to commercial agriculture, the conversion of mangroves have a cost which is often ignored in the market, but one that is no less important.



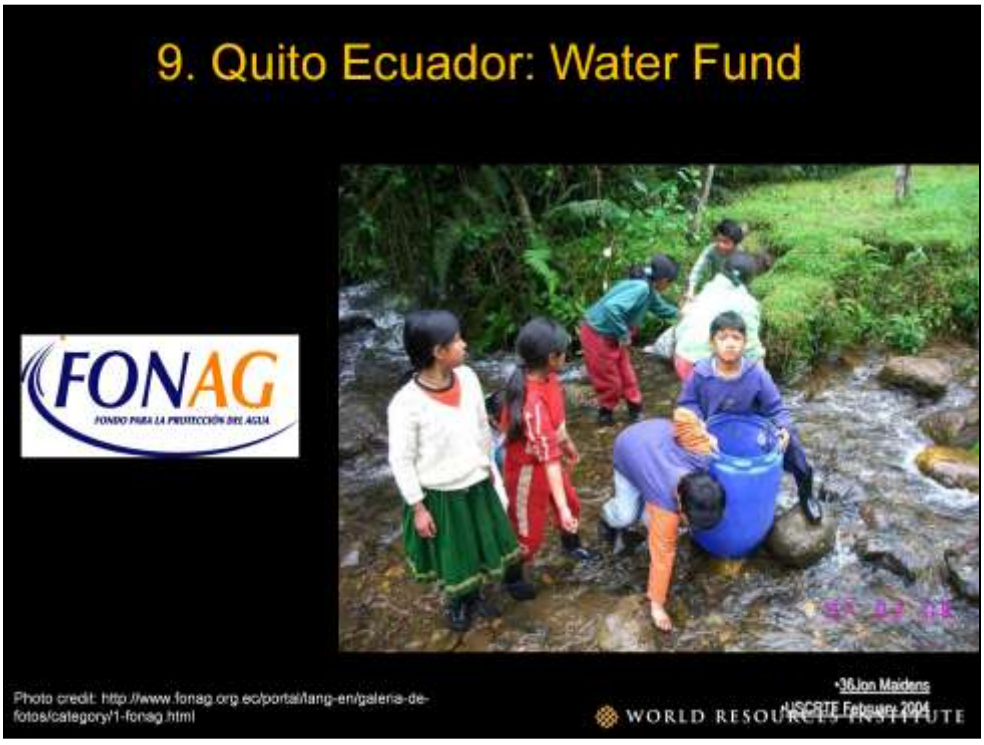
- In Southeast Asia and Central America, converting mangroves to aquaculture makes financial sense from the perspective of a shrimp farmer. One study in southern Thailand found that aquaculture had a net present economic value (using a 10% discount rate) of US$8,340 per hectare compared with only US$823 per hectare in economic value for an intact mangrove.
- If, however, the ES approach is taken into account, the social values of intact mangroves and shrimp farms reveals the net present value of intact mangroves to be in the region of US$35,696 per hectare versus negative US$5,443 per hectare for shrimp aquaculture.
- Even if the mangrove restoration costs are excluded, the mangrove benefits are still greater than aquaculture.
- To address these impacts, several policy options are available. Subsidy systems can be revised to reflect more accurate social worth of projects. Aquaculture strategies can be revised to include the use of certification programs. Government and large retailers can help drive certification by adopting sustainable procurement policies.
- Take into account all factors, subsidies, coastal benefits of mangrove, pollution costs, the cost-benefit analysis changes and the shrimp yield falls off. If you look at just the value of aquaculture, then there is a benefit, but if you look at the value of mangroves to commercial fisheries and the temporal scale it changes. Shrimp farms are degraded in seven years.
- Take the case of ethanol. If we had thought about it from a systems perspective, we would have realized the many other land-use change effects. Processing corn to fuel creates a big negative. WRI missed this in our analysis because WRI did not systematically think

through all tradeoffs.

- Here is an example from today's readings. The IFC revised their principles and now any IFC contribution requires investors to act in a certain way. This has influenced 72 financial institutions with $18 billion in 2010.

- Of course it is just a commitment. IFC is very competitive. They really want to do this because they want their performance standards to be the best of the best.
- What was really crucial was that we did work from the business council perspective. We have businesses come in and say “yes, we did it and here is how and what is required, which is not a lot.”

- Other organizations are starting to adopt similar strategies.



- Quito, Ecuador established a water fund in 2000 to protect upstream lands in order to maintain water flows and water quality.
- The fund's were principally raised by the city's water utility (via a levy), a local brewer, a bottler, and a hydroelectric company. The fund was established after being conceptualized and promoted by The Nature Conservancy.
- The principal funds were invested in stocks and other financial instruments and were allowed to grow before interest earnings were used to finance forest restoration projects, which are selected by an independent governing body.
- By late 2010, more than 2 million trees have been planted and more than 5,000 acres of land have been restored (Whelan 2010).

FONAG – the Fund for the Protection of Water:

- Launched in 2000 with $21,000 from TNC, USAID, & others.
- Regular cash flow from payments for water consumed—main contributors: water utility, local brewer, hydroelectric company.
- Interest earnings support conservation projects (selected by independent governing body).
- By 2010 > 2 million trees planted and 5,000+ acres land restored.

Photo credit: The Nature Conservancy: http://www.nature.org/photosmultimedia/photoofthemonth/photo-of-the-month-september-2010.xml

•37 Jon Maidens
•USCRTE February 2004

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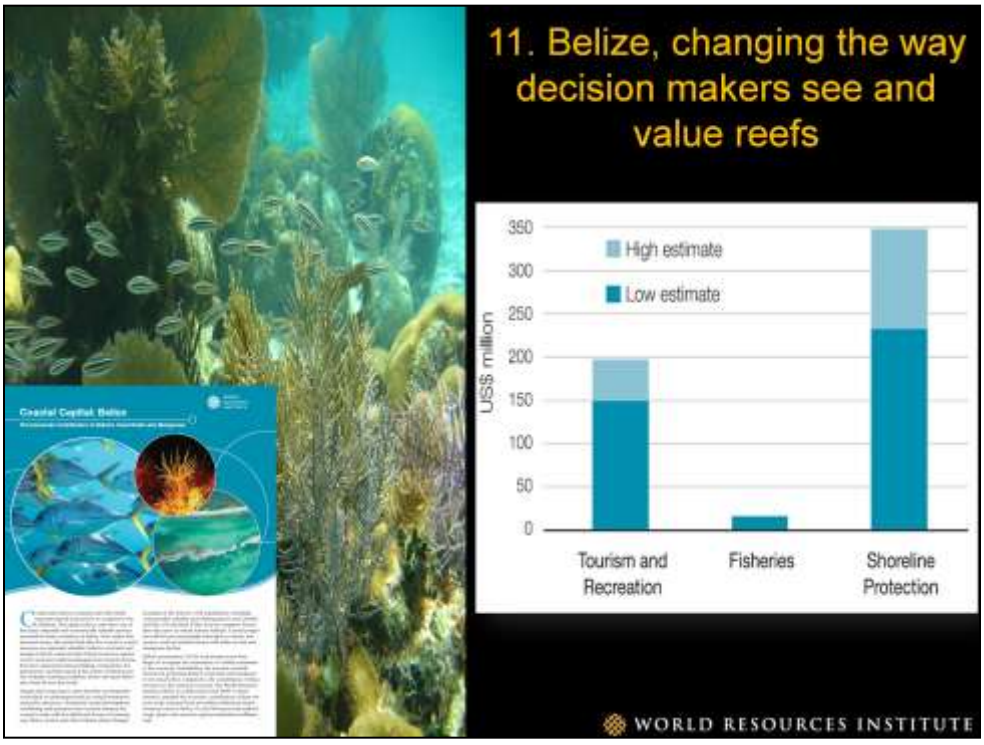
- U.S.-based electric utility, Allegheny Power, wanted to divest its 4,800-hectare Canaan Valley property in West Virginia.
- Traditional approaches appraised the real estate at $16 million. Believing that the property, with its pristine forests, marshes, and abundant wildlife, was worth more, the company commissioned an economic valuation of the marketable environmental benefits provided by the site, including its ability to sequester carbon and its wetlands. The eco-assessment boosted the total value to nearly $33 million.
- Allegheny Power subsequently sold Canaan Valley to the U.S. government, which merged it with an existing wildlife refuge, for the traditional appraisal price of $16 million. Using "bargain sale" provisions in the federal tax code, however, the company was able to claim a charitable contribution of $17 million for the property's environmental value, yielding several million dollars in tax-related savings.
- I do not know how we can recreate this, but it is an interesting opportunity.



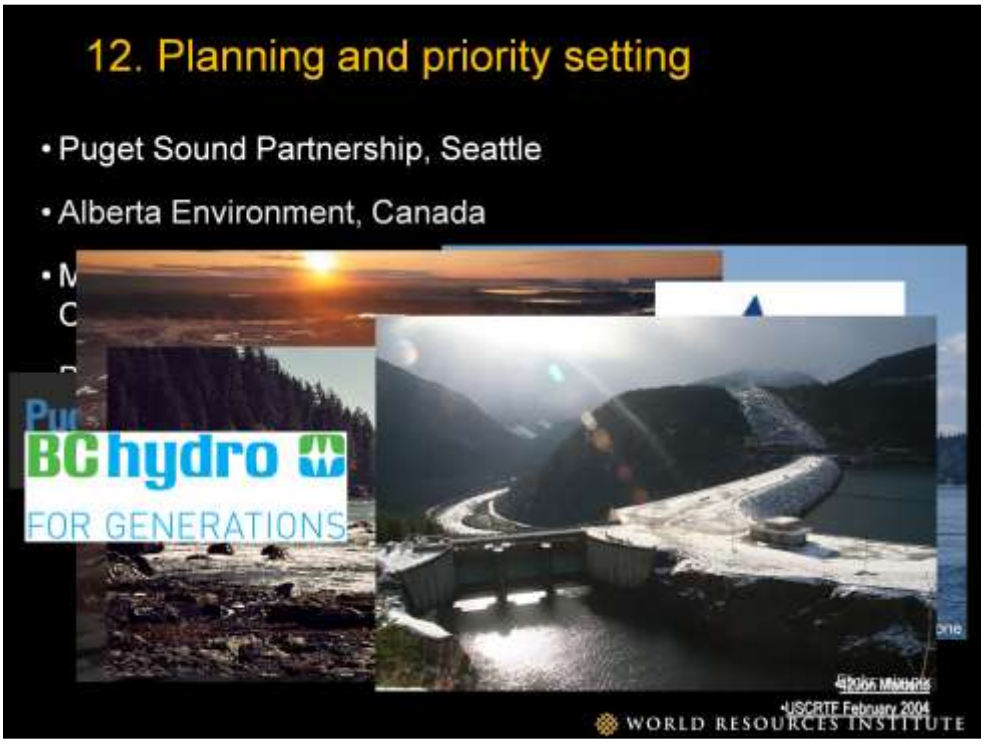
- I will share a story about our work in Belize to illustrate WRI's approach.
- Belize has some of the largest and most stunning coral reefs in the Caribbean, which are extremely valuable. They provide fertile ground for fishing, help protect the Belize shore, and are the backbone of tourism industry.
- The reefs are threatened even in the absence of a warming ocean. There are many threats to Belize's reefs such as overfishing, pollution, and poorly regulated coastal development.
- Part of the reason is that coral reefs are not fully valued by policy-makers. We developed a project with key partners to conduct an economic valuation of coral reefs and mangroves in the country.
- We found that benefits of fishing, shoreline protection, and tourism were significant, which has helped make the economic argument for greater investment in marine conservation.

    - ➢ What is the best way to communicate this to key decision-makers?

- There was active involvement of partner NGOs in the study. Together, we completed a strategic launch of the work through videos and organized a big gala that the Prime Minister attended.
- The Prime Minister noticed this report and changed his mindset. New regulations were put in place including:

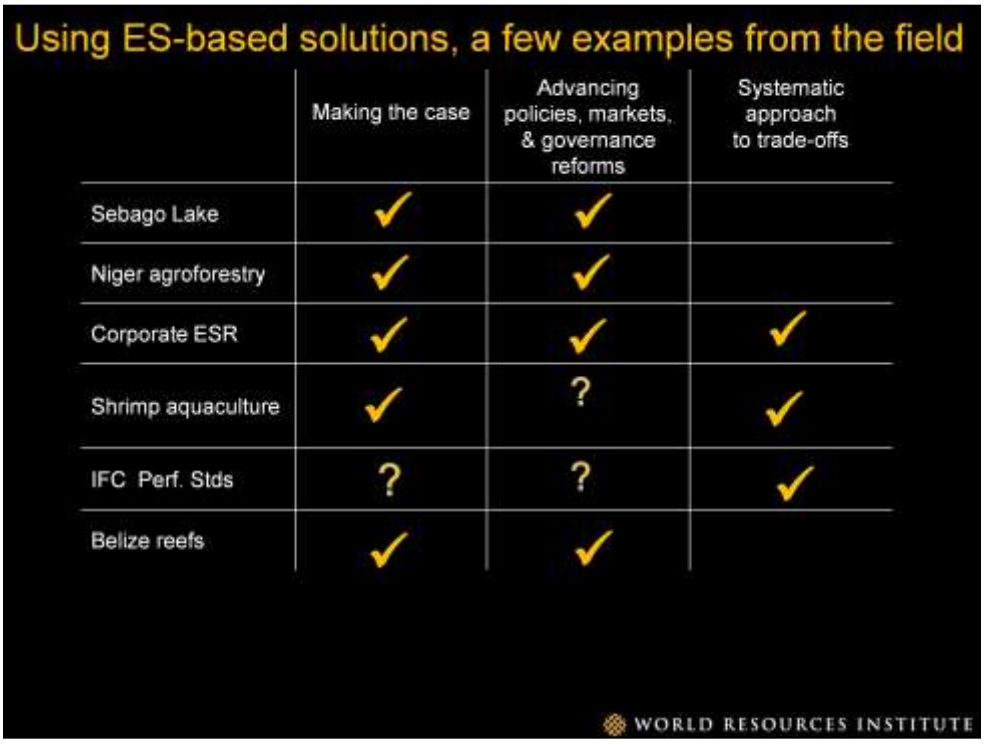
- Ban on Parrotfish fishing;
- Size limits on Grouper;
- Ban of spear fishing in MPAs; and
- Skin patch on fish filets.

- There were some unexpected outcomes related to our work in Belize as well. Our valuation informed the damage estimate of the Westerhaven grounding in January 2009. This was also the first time Belize had ever sued a ship owner for damages. The Belize Supreme Court recently ruled that the owners must pay US$ 6 million.
- The government used ES valuation to sue this person. I would like to say it helped, but the ruling was reversed, which makes me think something happened there. Maybe we did not win this one, but maybe we will win the next one.
- This sets an important precedent for Belize that we believe can help change how reefs are valued and therefore protected across the Caribbean.
- It nicely illustrates how we deployed strong analysis, partnerships, and innovative communications to create this change.

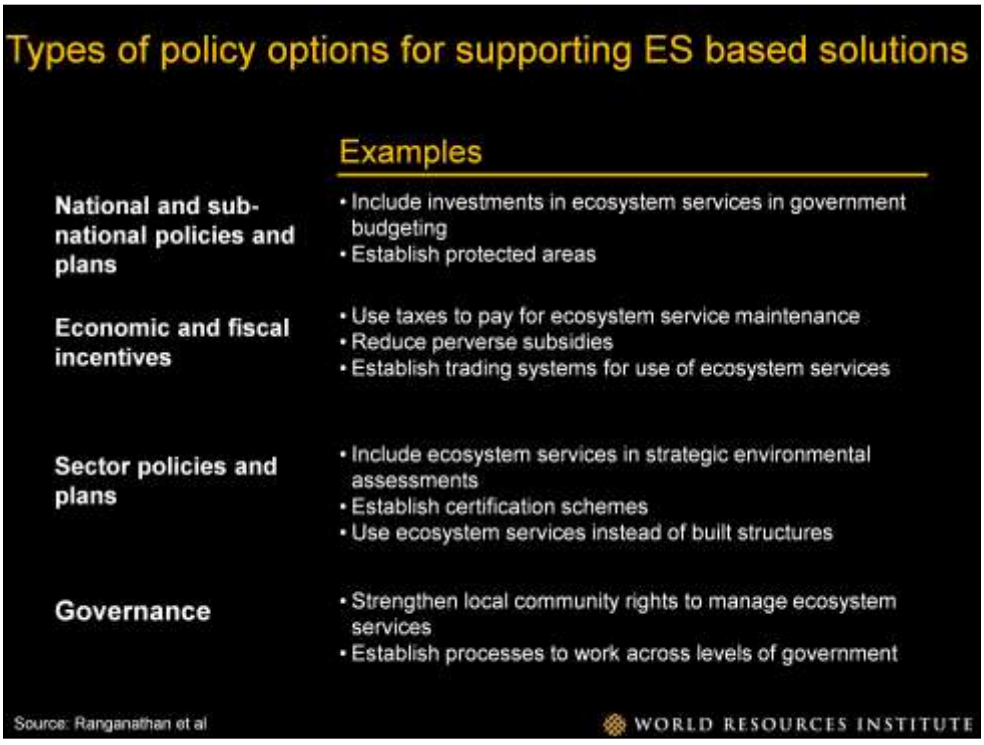


- Examples from Puget Sound and Alberta illustrate how people are using ES frameworks to think about design.
- The price tag of restoration will be large and residents of Seattle will have to pay the bill.
- Using ES argument was an effective way to show how it benefits the Seattle residents.
- Similar case with British Colombia Hydroelectric. It found itself operating a dam that was impacting a lot of people.
- They used an ES approach to model variables and impacts. They had representative groups come to the table, went through many iterations, and found a scenario where everyone could live with a particular operating plan.

- When I think about those examples I think they are doing some of these, not all of these but at least one.



- This table shows where I think the projects fall. For those that are too early to tell, there is a question mark.



- We do not have to rush to payment for ES (PES).
- Think about climate adaptation; it is not really a protected area, but it is protecting against climate change.
- Local communities need rights and empowerment so we can do a better job managing the tradeoffs.

Group Responses:

Participant

- You talked about winning the battle and losing the war and those were exciting examples that support that idea.

  - Is there one insight about one thing, that we can do to get ES on the mind of decision-makers?

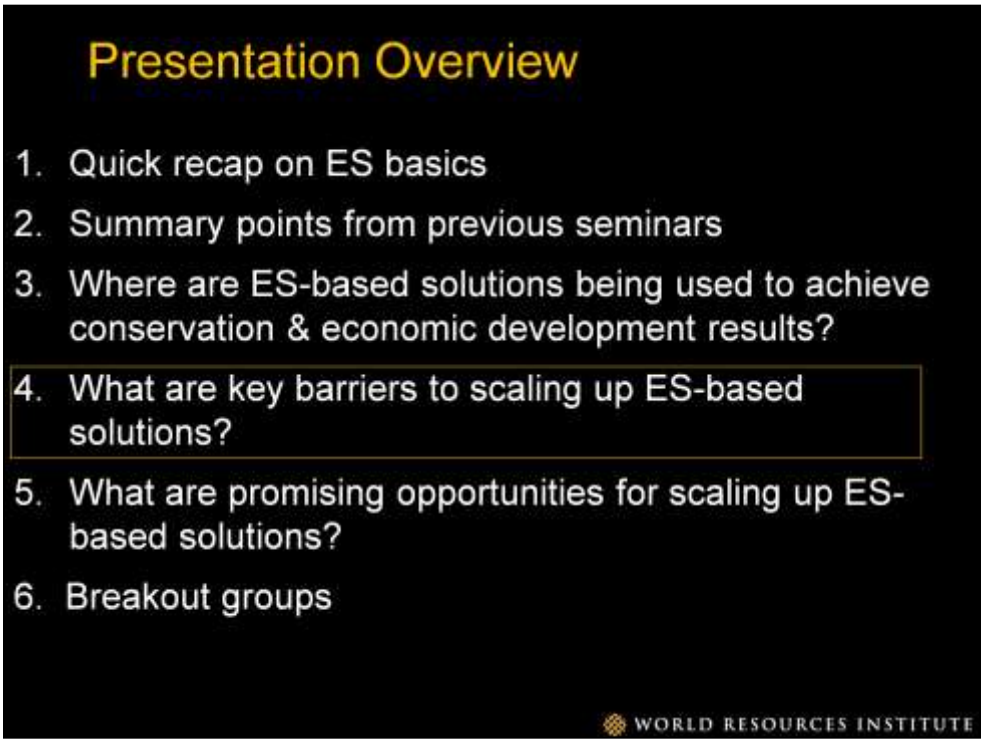
Janet Ranganathan

- I will answer that with another question:

  - What are those one or two key barriers to overcome?

- When you answer that, you will get that answer to your question. Let us talk about barriers, and get back to this question. The ES argument may not always make the case.

- In Ecuador, they discovered oil in some remote place and made a declaration that would not drill there. They wanted WRI to do a back of the envelop analysis to make the case to not drill based on nature's benefits. We could not make the ES argument that they wanted; there were plenty of services, but no beneficiaries.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3. Where are ES-based solutions being used to achieve conservation & economic development results?
4. What are key barriers to scaling up ES-based solutions?
5. What are promising opportunities for scaling up ES-based solutions?
6. Breakout groups
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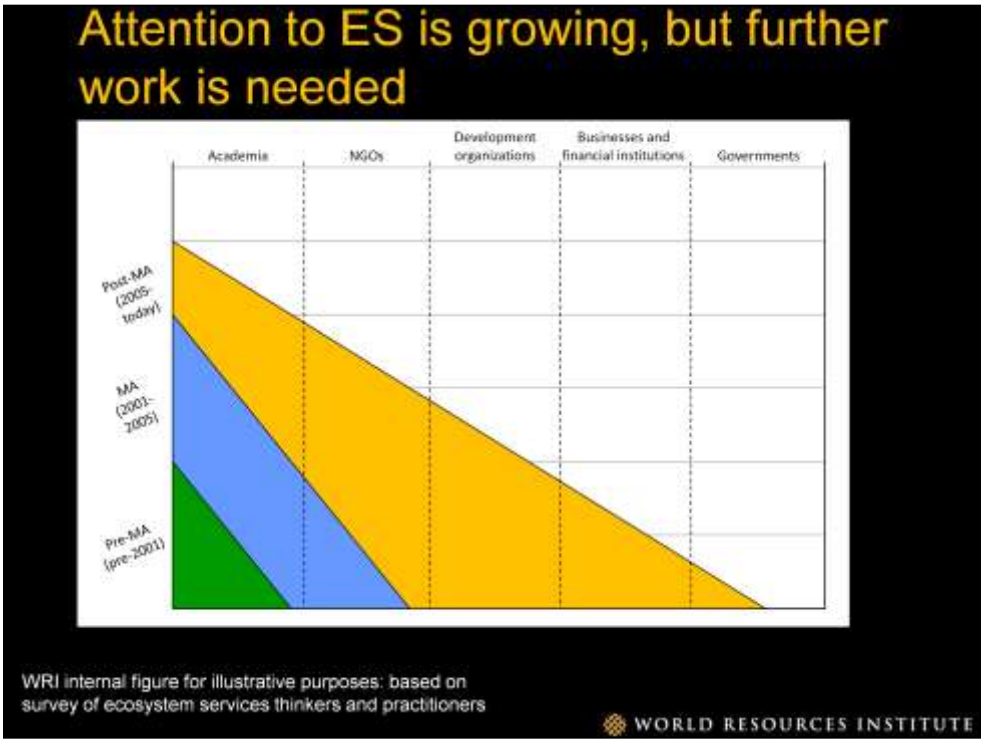


- The ES concept is becoming more mainstream; it is moving beyond environmental orgs to OXFAM and other development organizations like development banks and European bilateral organizations.
- The weakest of all is the government sector. This goes back to the comment about fragmentation in government.

<u>Group Responses:</u>

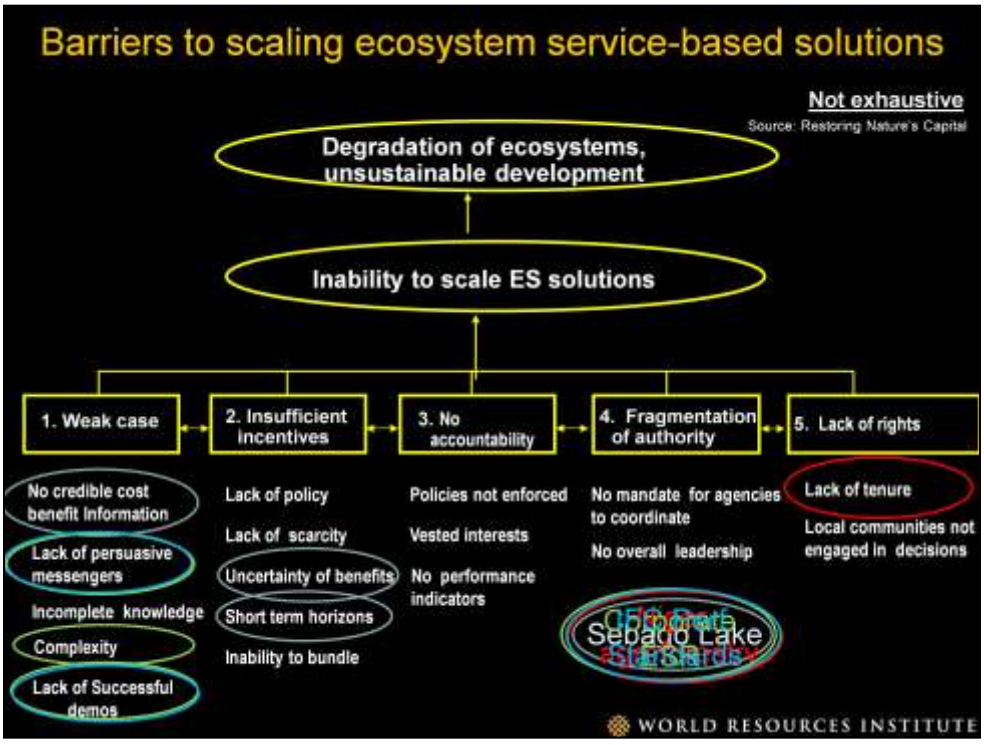
Participant

- I would argue that the two on the end tend to speak a very different language. Business like "Peter Rabbit English" that uses lots of numbers. Academics and NGOs are really good and making arguments in "non-Peter Rabbit" language. Constanza used language people could understand.

  - Is the reason for the slow uptake because of the volume on the other side?
  - Is there too much emphasis on the academic "non-Peter Rabbit English?"

Janet Ranganathan

- Yes, I think we need to move in that direction.



- The slide identifies five key lessons to take away from the MA:
  - The connection is being made, but it is weak.
  - Degraders do not pay; there are poor incentives to sustain services.
  - There is little transparency and accountability in decision-making.
  - There is a fragmentation of authority.
  - Property rights are critical issues in developing countries; in most places, landowners do not have rights to the land they work. It is different in the United States; here we need more “down steam” rights.
- Some organizations have not been conservation focused and it hurts their assessment and the movement. Al Gore may not have been the messenger for climate change; it was too political and focused on problems instead of solutions.
- We need to get mayors and municipalities to be the champions. We have to focus more on the local.
- We can start to manage risks by bringing in insurance companies.
- In the ESR, we did not just develop guidelines, we road tested it with six companies to rewrite guidelines in a more robust way. When we launched it, we got companies to talk about it to other companies. Similar to the example from Niger, the impact of your neighbor’s advice is much more powerful than an outside source.
- There is no silver bullet; each case has its own barriers.

Group Response:

Participant

- Can you say more about lack of scarcity?

Janet Ranganathan

- Scarcity is not all of it. It is political and biophysical too.

Participant

- What about short-term horizons? For instance, a municipality is looking at a 10 year plan while politicians look on a four year time scale.

Janet Ranganathan

- It is difficult and there is no easy answer. These things are very dependent on this but I am not certain. What do other people think about this?

Participant

- My only answer is to team up with people. From more of a policy perspective, sometimes you cannot compete alone and you need to find other allies to combine issues and become more persuasive.

Participant

- In general, at the local level, we are having a hard time getting investment because everyone is cutting back.

- Idea of investment still needs selling. How do we tackle that?

Janet Ranganathan

- It could work both ways. If you can show that being green is more cost effective, then you can garner support. These issues are not insurmountable, they are strategic problems.

Participant

- There is a strong sense that there is no shared community; latest EcoAmerican poll shows that there is a decline in shared solutions. If you do not believe there is some connection between you and your neighbor, you will not think there is a connection between you and the ecosystem.
- Really survey what your audience needs to make a decision. Ease, simplicity, relevant information, or whatever that be, find it and use it because you only have a limited shot and small window before they go back and retreat.

Participant

- Looking at this chart, it looks to me like it is specific to the international level. It seems to me we need to get it to a smaller level.

- Have you done this at a national level or a regional level?

Janet Ranganathan

- I have not done that; it may depend on what you are looking at, water or agriculture, etc.

Participant

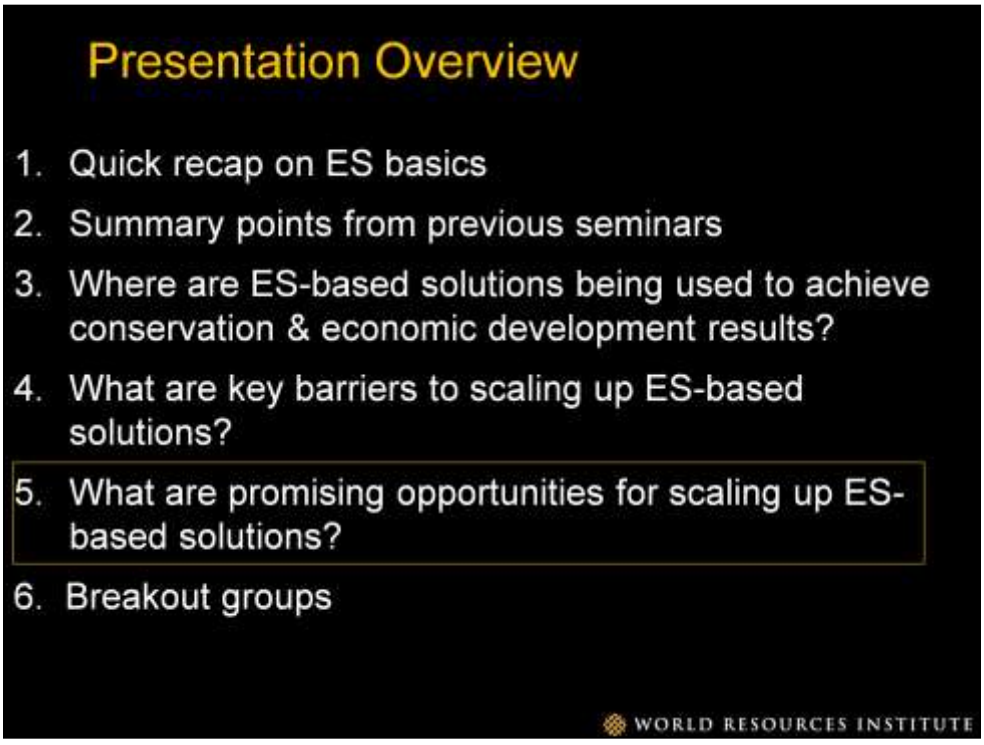
- If you did the inverse of this chart, it would show potentials. You could potentially use the inverse of this to select criteria of where to focus efforts.

Janet Ranganathan

- Focus on where can you make a strong case and then identify who your ideal messengers are.

Participant

- Focus on short-term horizons at a national level. Local governments are elected for a short-term and so they are only looking at the short-term. This demonstrates the lack of community, which is an important constraint.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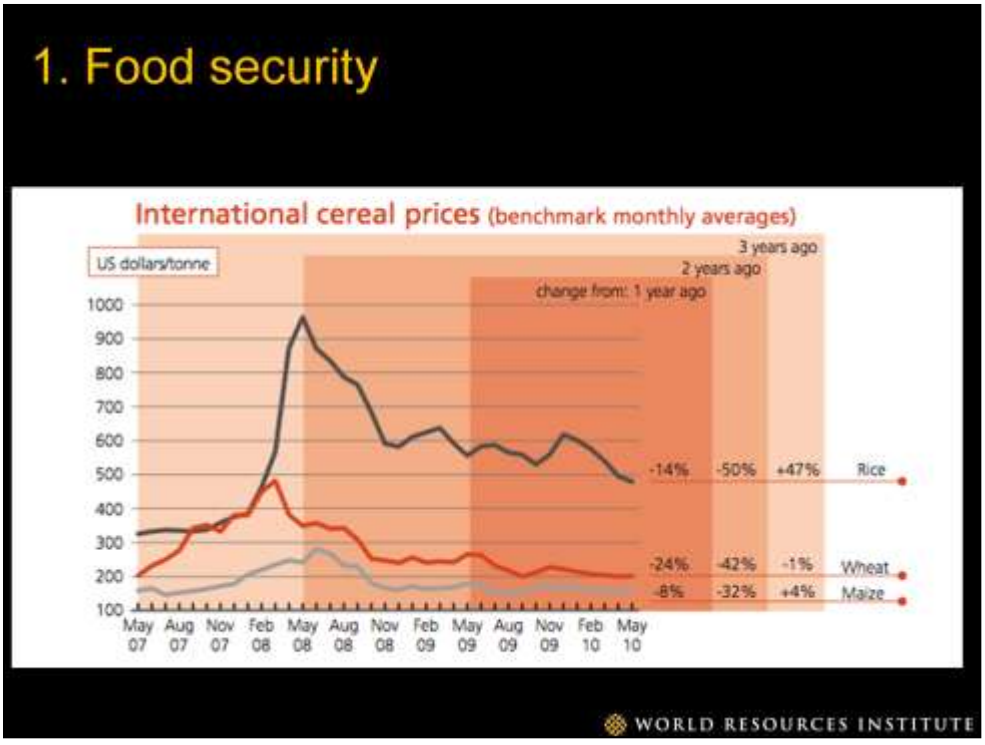
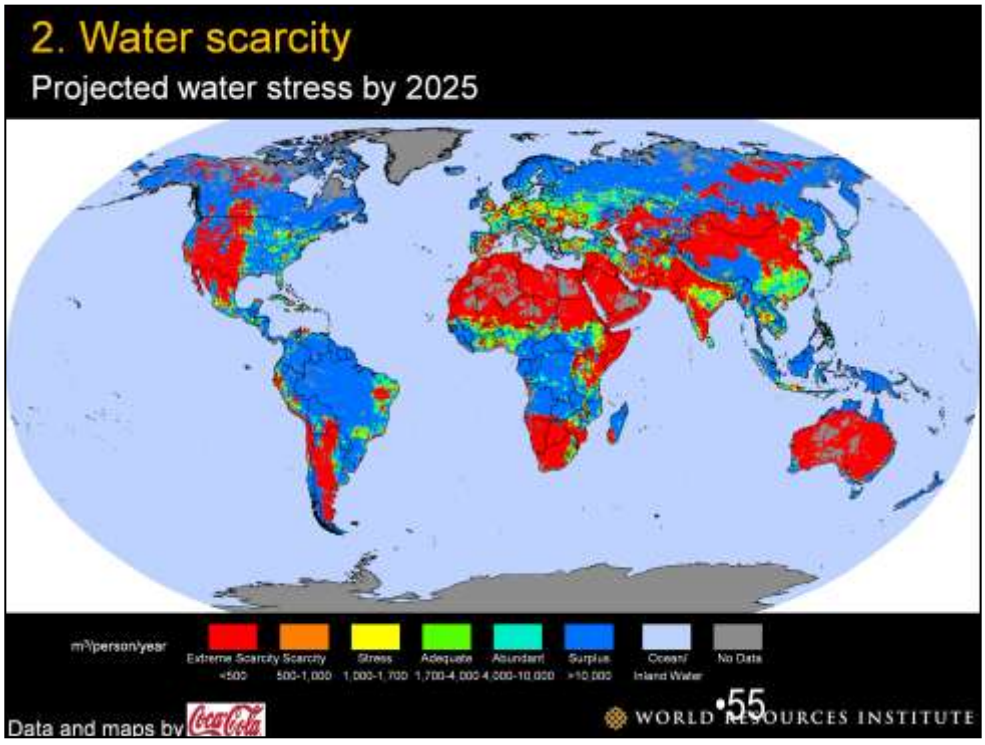
- One conclusion we came to was about how we need to be more strategic about our entry points in the next phase.
- We need to identify the existing priorities and where ES can assist is pursuing strategies.
- There are three areas that come to mind. For me, they are:
    - Agriculture/food security;
    - Water; and
    - Climate.
- These are already on the agenda so we do not have to make a huge case for their importance.

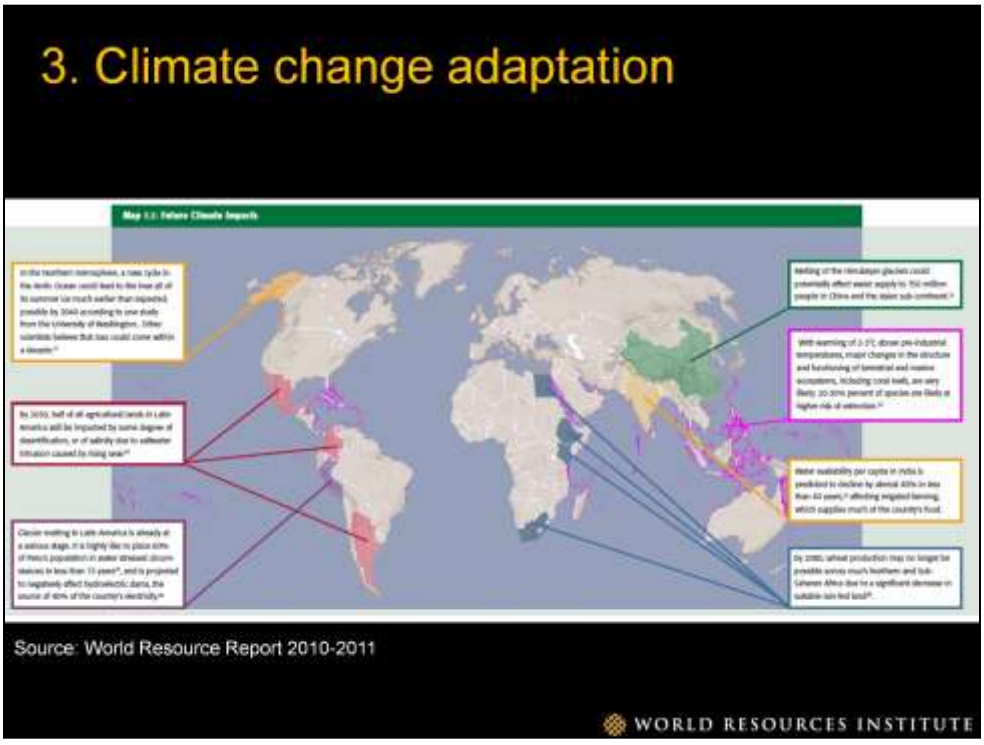


- If you think globally, the poorest people are usually farmers and overlap with water issues.
- Food security is a big deal; there are nothing like riots to get people's attention. Now countries are bringing ministers of agriculture to the World Bank to talk about goals.

  - The United Nation's Millennium Development Goals end in 2015, what will replace them? Will we update them or will there be something else?
  - ES were not included in them the first time. Can we update them this time around to include ES to incorporate food security and the environment?

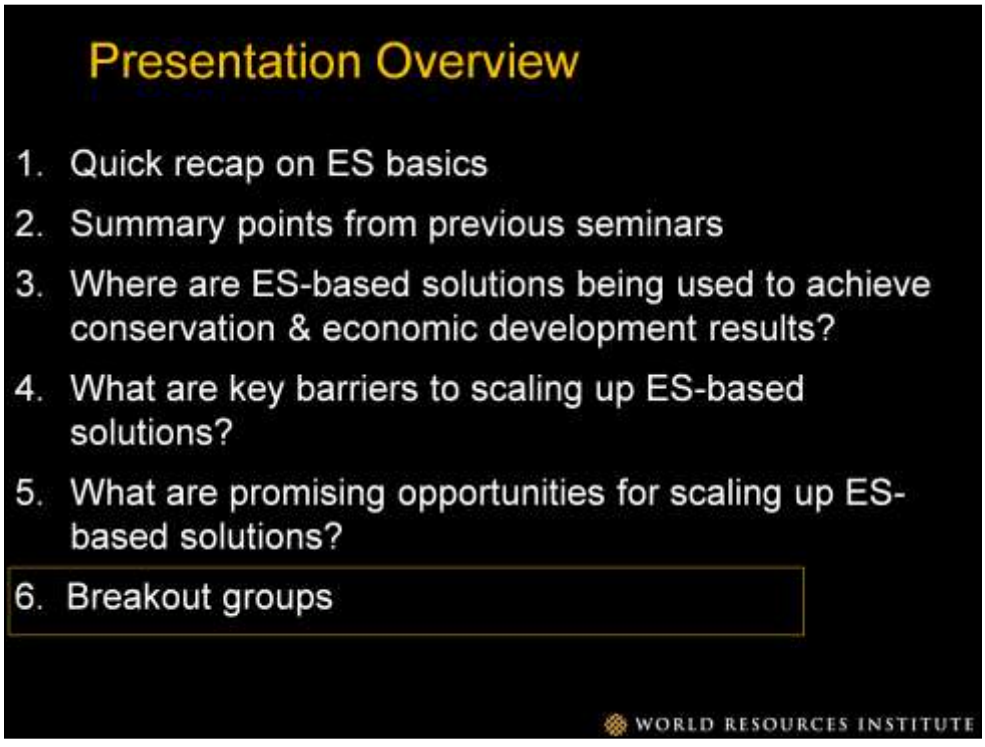


- A third driver putting pressure on food security is rising freshwater insecurity. This is particularly important given that about 70% of global human consumption of freshwater is for agricultural production.
- Our use is growing faster than population growth.
- As people move up the food chain in terms of diet (i.e., eat more meat), the amount of embedded water per calorie skyrockets.
- Inefficient water usage still persists worldwide.
- Water pollution further exacerbates the challenge by making less clean freshwater available.
- Maps like this one showing projected availability of freshwater for human consumption by 2025 paint a dark, or should I say “red”, picture.



- In Florida, where Tropicana grows oranges, they are dealing with more night time freezes. They pump out water and spray it at night to protect crops from night freezes.

  - Does this present an opportunity to make the case for climate change reversal as being more cost effective than spraying water?
  - How do you integrate ES into money going to climate change adaptation?


Presentation Overview
1. Quick recap on ES basics
2. Summary points from previous seminars
3. Where are ES-based solutions being used to achieve conservation & economic development results?
4. What are key barriers to scaling up ES-based solutions?
5. What are promising opportunities for scaling up ES-based solutions?
6. Breakout groups
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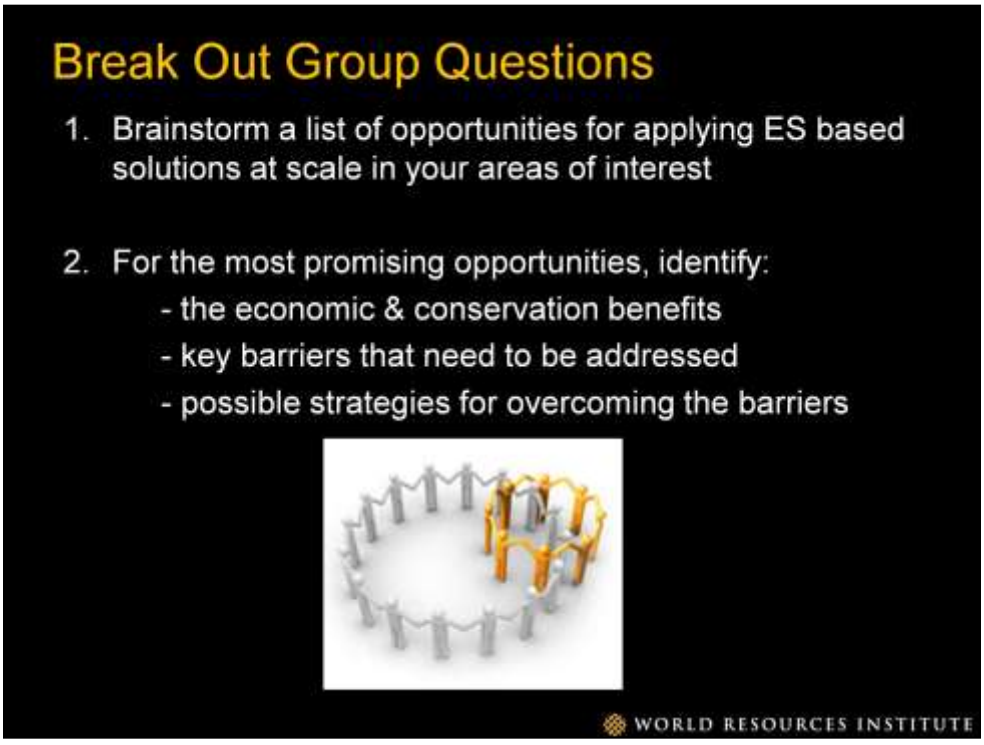


Group Responses:

Group 1

- Scales of interest
  - State
  - Regional
    - Needs
      - Connecting economic and conservation benefits.
      - Define audience and best way to reach them; the public community needs specific breakdowns that are credible while the voting community prefers to see the aggregate.
      - Communicate changes in the debate.
      - Different types of rights.
      - Find topics that cross barriers.
      - Evidence action with real numbers.
      - Benefit indicators.
      - Define change.
    - Barriers
      - Polarization from dialogue about government versus non-government.
  - South America
  - Private investment
  - Municipal linkages
  - Natural disaster related and risk of inundation (climate change)

    - Water fund investments
    - Government
    - Science implementation
    - Tools
    - Conservation economics
    - Communication
    - Watersheds
    - Foodsheds
    - Multi-Scale enabling conditions
- Communication
    - Needs to resonate with people; they need some sort of direct experience.
    - In each community, there may be a different vocabulary, but most want to discuss quality of life.
    - Define barriers and/or impediments to change: Who/what are they?
    - Showing certainty of benefits and debunking uncertainty are crucial.
    - Use demonstrations to ground ideas.
    - External actors need to work with internal actors in order to have an impact.
    - Need to find pathways to increase community understanding.
    - Use health and education and imminent threats.
    - Education vs. Self-interest to create rights-based change.
- Community-Engagement
    - Important to engage the community in all stages: prioritization, definitions, evaluation, etc.
- The end message is that we need to keep investing in this idea.

Group 2

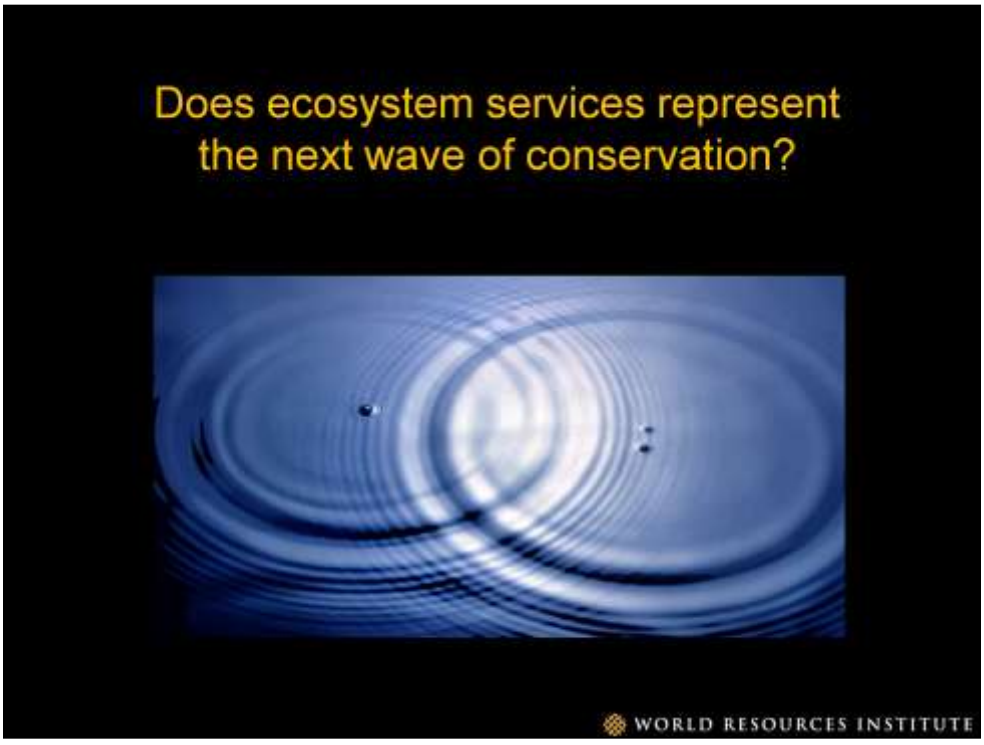
- Areas of Interest
    - Agriculture/Forest Transition
    - Fisheries (incentives, S.E. Asia)
    - Forests (Andes/Amazon)
        - Water, headwaters, carbon
    - Water/Sustainable Fisheries/Forest/Hydropower (British Colombia, Andes, Brazil)
        - Biodiversity values
        - Link to fisheries
        - Forests
        - Beyond local level functions

- Fresh Water
    - Opportunity Scales
        - Watershed
            - Look at key development imperatives in flood control, energy development extractive industry, fisheries, wildlife, habitat, access and control over resources, i.e., fisheries, resource/land tenure, and water quality.
        - Implementation jurisdictions
        - Local level
            - May have stronger case when working at the local level.
- Promising Opportunities
    - Develop forum to identify and develop agreements on tenure and create a vision.
- Barriers
    - Understanding value of externalities
    - Legal framework and land tenure issues
    - Insurance framework and policies
    - Increasing accountability in development
    - Assembly of different resources
    - Integrating ES into existing governance structures and making ties to economics and markets
    - Understanding poverty
    - Fractioning different values at different scales

Group 3

- Opportunities
    - We should focus on building the case through other issues and be more comprehensive. Some issues to focus on include:
        - Malawi
            - Carbon project/REDD;
            - Landscape scale; and
            - Food security.
        - California AB32
            - Cap and trade and
            - REDD.
        - Managing risk
        - Hazards

- Economics
- Land tenure and rights
    - More opportunities exist outside of the United States.
- California
    - Outcomes of investment
    - Need to recognize that there is enough science and we just need to start doing it.
    - Regulating review process is good for permit coordination.
- Assets
- National accounting
- Data accessibility
- Sierra Nevada, which could be a good pilot case.



Participant

- I am concerned about this becoming a bandwagon issues. ES is not mutually exclusive from other conservation tools.

Participant

- I would put a flag on the word conservation and change it to "Does ecosystem services represent the next wave of development?"

Participant

- ES is not a new idea; that is one idea we have discussed a great deal throughout this seminar.

Participant

- We need to focus on mainstreaming the concept not just the term.

Janet Ranganathan

- We need to focus on building constituencies and increasing demand for ES solutions. We can work on this and developing supply with examples, but we also need to work on the demand side.
- There is a challenge of working across scales where government and businesses do not have a mandate.

  - Can we create bridging organizations to help with this?

- These types of bridging organizations are sorely missing. We need to get people together and deal with tradeoffs that present themselves and not build more ivory towers.

    - Can we leverage investment more effectively to move beyond conservation to include issues that are important to the areas where people are working?
    - Can we leverage different kinds of funders to work together for more dynamic aspects?

- We should work to promote larger scale projects and move away from stand alone work. Let us encourage experimentation in all focus areas and all scales.
- Let us think outside the box to develop nature-based solutions.

    - How can we get venture capital into this space?

- Let us work on a bottom-up effort with active collaborative action between funder, grantee, and communities (local leaders etc..).

    - How can we all work together and create real beneficial change?


Thank you
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Annex
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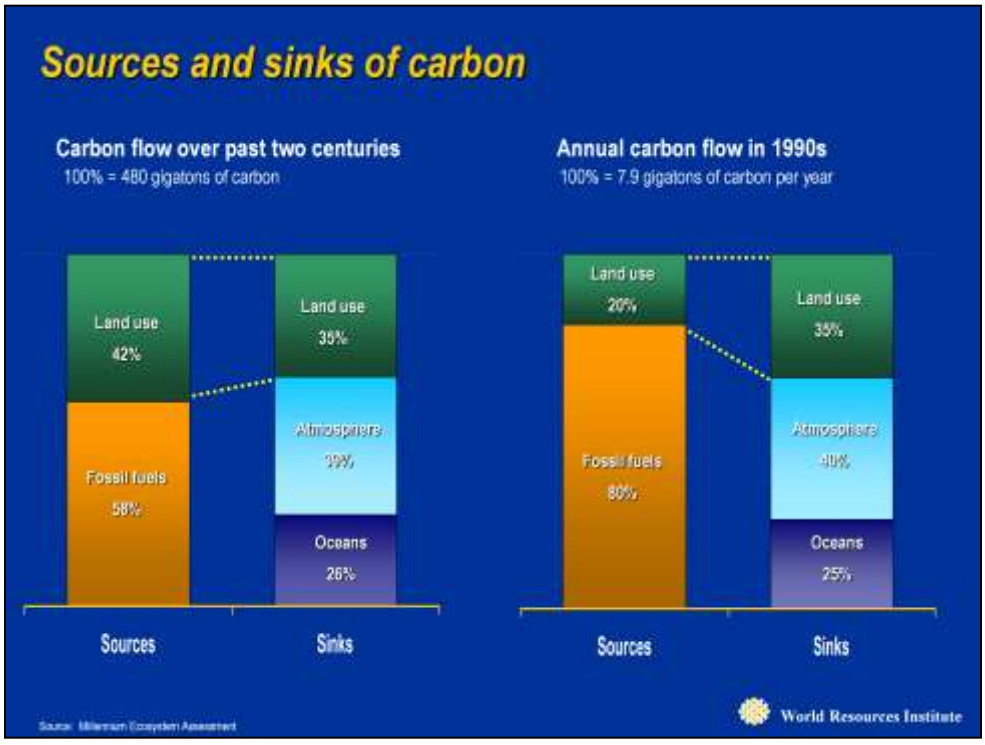
Sources and sinks of carbon
Carbon flow over past two centuries
100% = 480 gigatons of carbon
Land use
42%
Fossil fuels
58%
Land use
35%
Atmosphere
39%
Oceans
26%
Sources
Sinks
Annual carbon flow in 1990s
100% = 7.9 gigatons of carbon per year
Land use
20%
Fossil fuels
80%
Land use
35%
Atmosphere
40%
Oceans
25%
Sources
Sinks
World Resources Institute

- Examples: Niger, Bangladesh fisheries (2007 WRR), USDA conservation reserve program.

- Water fund, catskills, Dwardi village (2007 WRR).


Climate change Adaptation – Illustrative activities
✓ Land use planning
✓ Zoning e.g., "Protected adaptation zones"
✓ Grey versus green e.g. mangrove & wetland restoration
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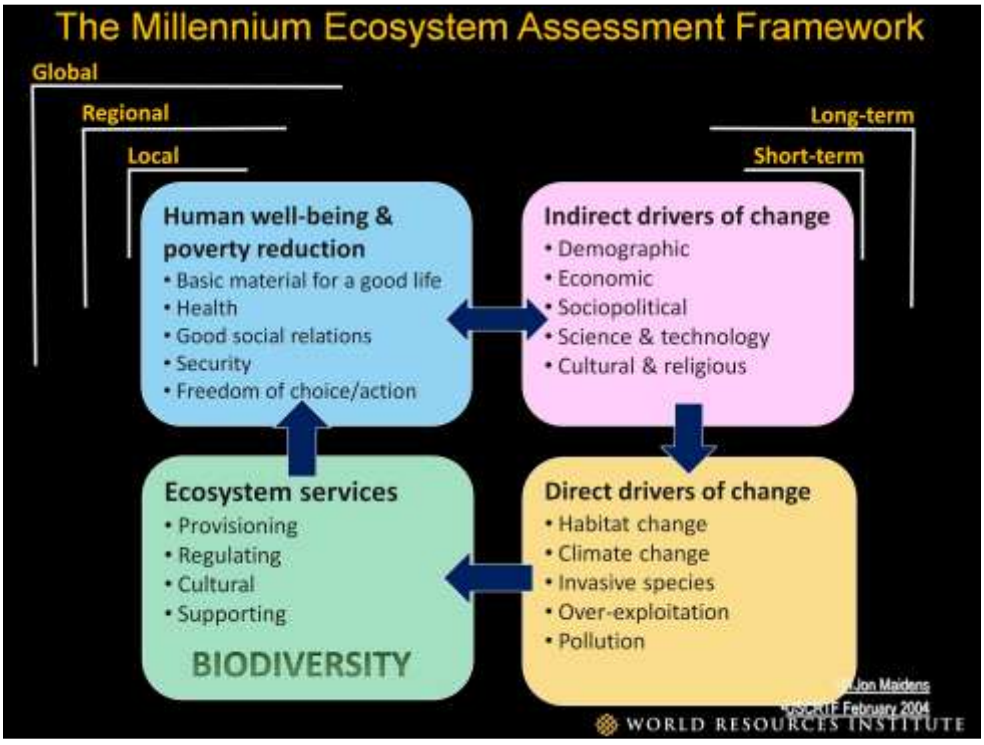
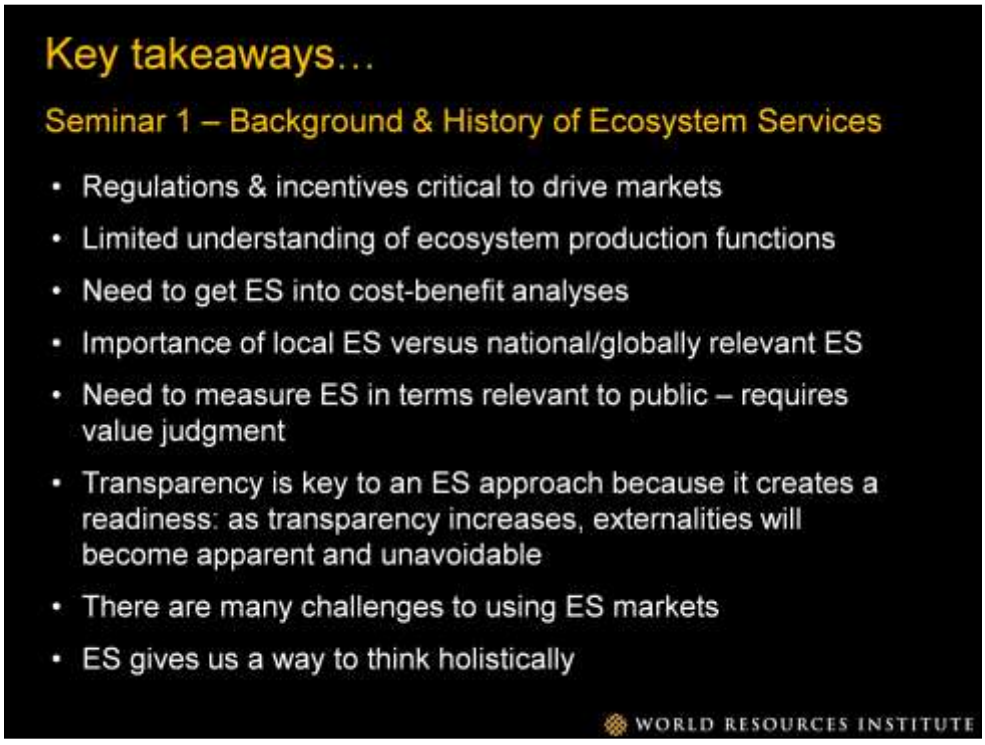
- WRI's assessment is that the "ecosystem services movement" has gained traction among influential pockets of the business, academic and NGO communities. Awareness of the concept of ecosystem services has grown. National and sub national ecosystem service assessments are being conducted. Ecosystem service-based markets are emerging. A variety of actors are now paying attention to ecosystem services, much more so than in the past. And yet, much remains to be done to mainstream investments in ecosystem services by national governments and the economic development community.


The Millennium Ecosystem Assessment Framework
Global
Regional
Local
Long-term
Short-term
Human well-being & poverty reduction
• Basic material for a good life
• Health
• Good social relations
• Security
• Freedom of choice/action
Indirect drivers of change
• Demographic
• Economic
• Sociopolitical
• Science & technology
• Cultural & religious
Ecosystem services
• Provisioning
• Regulating
• Cultural
• Supporting
BIODIVERSITY
Direct drivers of change
• Habitat change
• Climate change
• Invasive species
• Over-exploitation
• Pollution
Jon Maidens
RISCRTF February 2004
WORLD RESOURCES INSTITUTE


Key takeaways…
Seminar 1 – Background & History of Ecosystem Services
• Regulations & incentives critical to drive markets
• Limited understanding of ecosystem production functions
• Need to get ES into cost-benefit analyses
• Importance of local ES versus national/globally relevant ES
• Need to measure ES in terms relevant to public – requires value judgment
• Transparency is key to an ES approach because it creates a readiness: as transparency increases, externalities will become apparent and unavoidable
• There are many challenges to using ES markets
• ES gives us a way to think holistically
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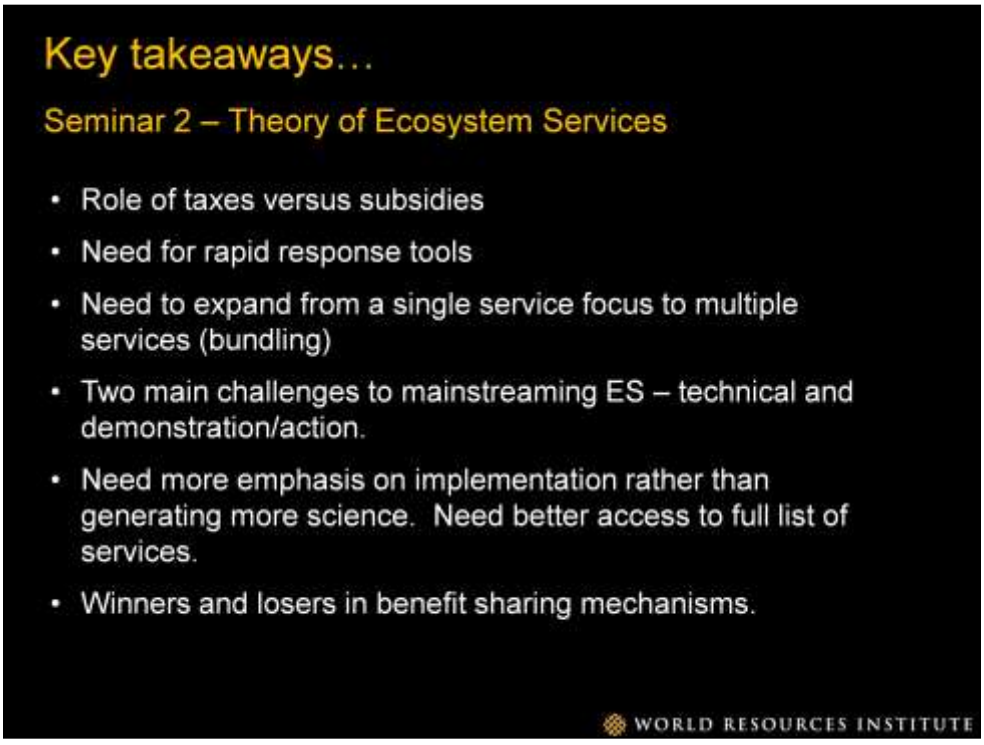
Key takeaways…
Seminar 2 – Theory of Ecosystem Services
• Role of taxes versus subsidies
• Need for rapid response tools
• Need to expand from a single service focus to multiple services (bundling)
• Two main challenges to mainstreaming ES – technical and demonstration/action.
• Need more emphasis on implementation rather than generating more science. Need better access to full list of services.
• Winners and losers in benefit sharing mechanisms.
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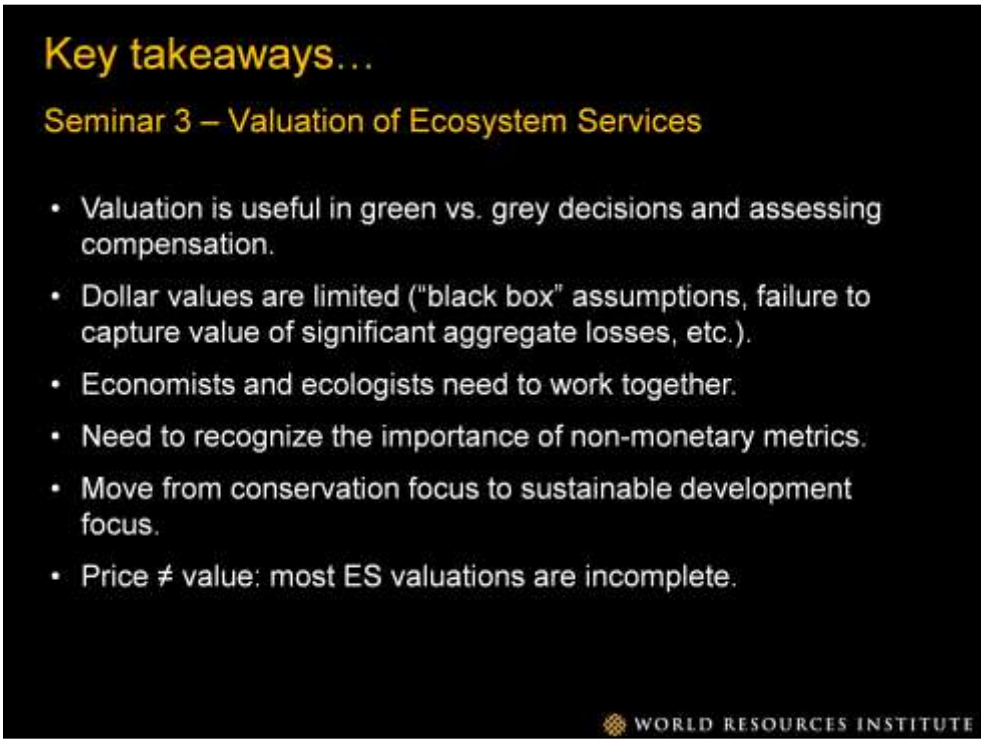
Key takeaways…
Seminar 3 – Valuation of Ecosystem Services
• Valuation is useful in green vs. grey decisions and assessing compensation.
• Dollar values are limited ("black box" assumptions, failure to capture value of significant aggregate losses, etc.).
• Economists and ecologists need to work together.
• Need to recognize the importance of non-monetary metrics.
• Move from conservation focus to sustainable development focus.
• Price ≠ value: most ES valuations are incomplete.
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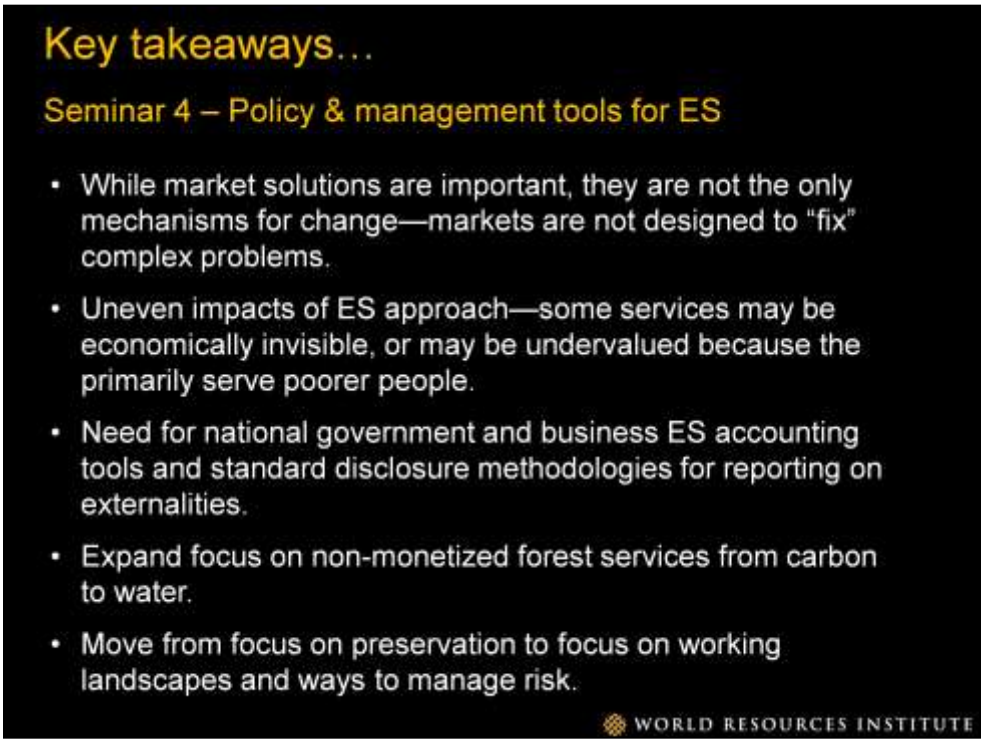
Key takeaways…
Seminar 4 – Policy & management tools for ES
• While market solutions are important, they are not the only mechanisms for change—markets are not designed to "fix" complex problems.
• Uneven impacts of ES approach—some services may be economically invisible, or may be undervalued because the primarily serve poorer people.
• Need for national government and business ES accounting tools and standard disclosure methodologies for reporting on externalities.
• Expand focus on non-monetized forest services from carbon to water.
• Move from focus on preservation to focus on working landscapes and ways to manage risk.
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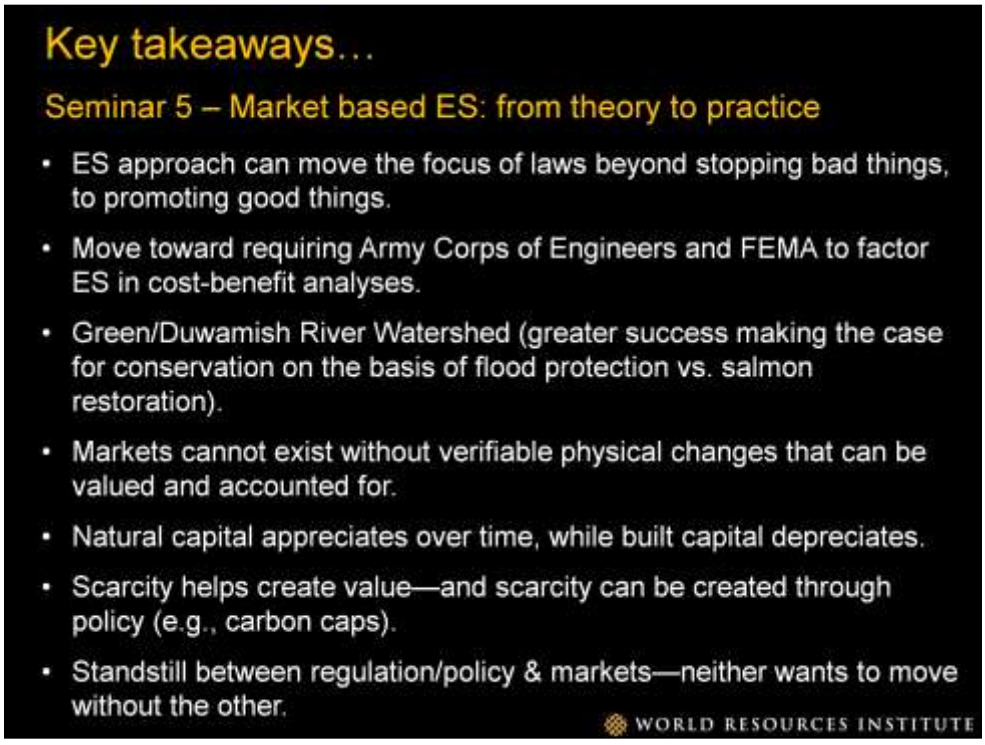
Key takeaways…
Seminar 5 – Market based ES: from theory to practice
• ES approach can move the focus of laws beyond stopping bad things, to promoting good things.
• Move toward requiring Army Corps of Engineers and FEMA to factor ES in cost-benefit analyses.
• Green/Duwamish River Watershed (greater success making the case for conservation on the basis of flood protection vs. salmon restoration).
• Markets cannot exist without verifiable physical changes that can be valued and accounted for.
• Natural capital appreciates over time, while built capital depreciates.
• Scarcity helps create value—and scarcity can be created through policy (e.g., carbon caps).
• Standstill between regulation/policy & markets—neither wants to move without the other.
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Key takeaways…
Seminar 6 – Management decisions in the public sector: theory to practice
• Need to make ES operational – move beyond the conservation community into application.
• Investing in ecosystems to achieve development goals.
• Need to produce more info that is relevant to and useable by decision makers.
• Methods to link science with management decisions need to include risk, resilience, and vulnerability elements.
• Regulatory mitigation is just one tool. Approaches should be about avoidance first—minimize second, and mitigate last.
• Systems/processes not perfect; need better performance measures. Processes should be simple, replicable, transparent, and communicable.
• Replacement should be last line of defense – move toward policies that avoid damages and enhance services.
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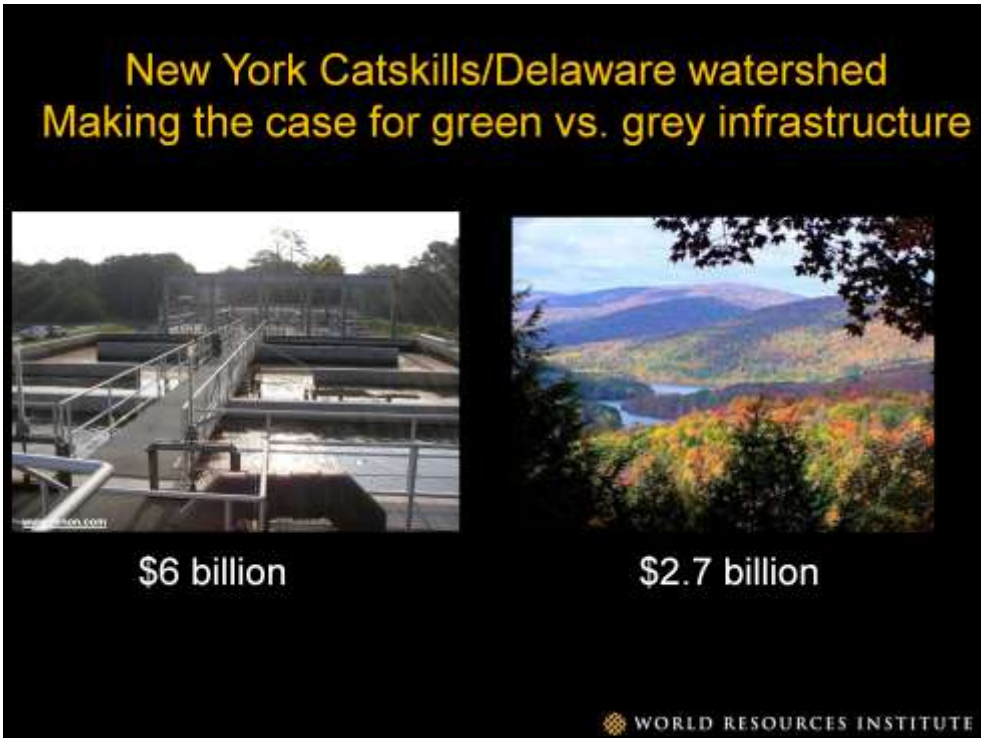

- New York City's (NYC) tap water has never passed through a filtration plant. The Catskill/Delaware watershed provides NYC and surrounding areas with 90% of their water supply (an average 1.3 billion gallons of drinking water per day), which is filtered naturally through the ecosystem's wetlands and waterways. In the late 1980s when the watershed was severely degraded by development, NYC considered building a filtration plant. Instead of building a US$6–8 billion plant (estimate does not include operating costs) as initially proposed, they decided to spend $1.5 billion to restore and conserve the Catskill Mountains watershed.
- This example highlights how economic and financial incentives can be aligned with goals that support both development and ecosystems. In the case of the Catskill/Delaware watershed, the payment for the natural water purification services also provides other services - carbon storage and recreational and cultural services at no additional cost.