



Future Expectations of Corporate Environmental Performance

Emerging Ecosystem Services Tools and Applications

BSR's Environmental Services, Tools, & Markets Working Group
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About this Report

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The document is based on a literature review as well as discussions with, and presentations from, thought leaders in the ecosystem services field, who are listed in Annex 1. Any errors in the report are those of the authors alone.

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Executive Summary

There are increasing signals that a “game changing” paradigm shift in environmental thinking is underway—with the potential to significantly expand stakeholder expectations of corporate performance. Although the exact timing and geographic locations of uptake remain uncertain, the trend is becoming clear.

Environmental thinking is broadening—from discrete issue management to inclusion of how business impacts may be affecting landscape-level ecological dynamics, such as the flows of ecosystem services.

If trends play out, then it is likely that stakeholders will demand that corporate reporting include not only specific impacts—such as waste flows, corporate greenhouse gas emissions, water usage, and other parameters—but also information that contextualizes this data within watershed, landscape, or even regional dynamics. Advocates assert that consideration of ecosystem services allows for understanding particular environmental impacts within the context of ecosystem structure, function, and flows of services.

As expectations begin to shift, corporate leaders have begun to make commitments related to ecosystem services and develop new practices. Concurrently, there are emerging government actions, as well as expectations of activists, investors, and other stakeholders. Ecosystem services initiatives have been launched in relation to the International Standards Organization (ISO 14,001), the Global Reporting Initiative (GRI) and the Global Compact’s Performance Model (GCPM). If momentum builds, then these efforts will, in turn, drive a need for identification, measurement, assessment, and potentially even valuation of both impacts and dependencies on ecosystem services within the landscapes in which businesses operate. In response to emerging demand, ecosystem services decision-making tools are in development.

This report offers a “point in time” assessment of the ecosystem services tools domain as well as potential interface points with existing corporate governance, strategy, and operations decision-making processes. The report should be understood as a snapshot, as many tools are still in development, and corporate applications remain limited, particularly in terms of publicly available, independent assessments of individual tools’ added value within corporate settings. The coming years will deepen insights.

At this juncture, BSR’s Environmental Services, Tools, and Markets Working Group is focused on the emergent ecosystem services tools with the greatest potential for integration within corporate decision-making processes. We hope this report contributes to the ongoing discussion of how to consider ecosystem services within corporate decision-making processes.

Early Signs of a Shift to an Ecosystem Services Paradigm for Environmental Performance Expectations

Stakeholder Expectations

- » Academia, think tanks, and moderate NGOs (e.g. WWF, the Nature Conservancy, WRI, Conservation International, Environmental Defense, Stanford University, and Duke University) are embracing ecosystem services and market-based approaches.

Public Agencies and Regulatory Frameworks

- » Agencies are considering fundamental changes to manage environmental issues as part of complex systems rather than in terms of individual flows of energy, waste, and water

Investors and Investment Markets

- » Trendsetters are incorporating ecosystem services into their research and analyses of companies (e.g. Goldman Sachs and the UNEP Finance Initiative).

Introduction

As stakeholders and politicians continue to focus on climate change—as well as increasingly, water and biodiversity—a growing number of **thought leaders are advocating that ecosystem services offer a way to aggregate multiple seemingly disparate environmental issues within a systems-based framework.** While discrete environmental parameters—related to carbon/greenhouse gas emissions, water usage, and waste, for example—will remain important, NGOs and government agencies are increasingly interpreting this data within a broader context of ecosystem structure and function.

Within this changing context, business decision-makers are likely to find ecosystem services considerations relevant. (For more detail on elements of the business case, see BSR’s [“Executive Briefing on Environmental Markets”](#)). Corporate managers will face a growing number of environmental performance questions—including both today’s standard issues (related to emissions and waste) and tomorrow’s considerations of business impacts on the structure and function of ecosystems and their ability to provide services (ranging from water filtration to habitat for pollinators).

The core question is whether specific ecosystems in places of business operation can fully function and provide the services upon which society relies. **Corporate decision-makers will, in turn, have to consider how to avoid, lessen, or even mitigate impacts in order to optimize ecosystem function within the context of business operations.**

This report explores the future of business decision-making processes within the context of this emergent set of ecosystem-services-related questions and potential stakeholder expectations. It lays out the implications of ecosystem services thinking for companies. The report also provides details on the new set of tools for decision-making. Finally, it describes generic types of business decision-making—including governance, strategy, and operations—and identifies potential “integration points” where ecosystem services tools could be used in order to improve risk management and due diligence processes, as well as possibly stakeholder engagement and opportunity identification processes.

In issuing this report, BSR’s intention is to deepen the discussion around ecosystem services and their potential applicability to corporate decision-making processes. However, it is a point-in-time analysis, as ecosystem services tools remain an emergent domain that has yet to benefit from an independent, publicly available review of tool applications.

Within this emergent moment in time, corporate decision-makers have the opportunity to track the issues and explore whether, how, and when today’s emerging issues could become tomorrow’s mandate. For companies, the task of developing a ‘point of view’ on ecosystem services issues offers the full range of risks and opportunities that exist for any horizon issue, particularly for one that tackles the complexity and interconnectedness intrinsic to functioning ecosystems.

Scientific Consensus around the Ecosystem Services Concept and Trends

The concept of ecosystem services is gaining advocates among academics, NGO representatives, and government officials around the world. The services that society derives from functioning ecosystems include:

- » purification of air and water
- » generation and renewal of soil and soil fertility
- » pollination of crops and natural vegetation
- » control of agricultural pests
- » dispersal of seeds and translocation of nutrients
- » maintenance of biodiversity
- » support for diverse human cultures

The 2005 Millennium Ecosystem Assessment, which assessed the status of these services, was a milestone in support of the ecosystem services concept. In the assessment, 1,300 scientists from 95 countries found that 60 to 70 percent of ecosystem services globally are being degraded more quickly than they can recover.

In light of these and other findings, scientists, thought leaders, and government officials globally are calling for greater attention to ecosystem services, on which business and society rely.

The Next Dimension of Corporate Environmental Performance Expectations?

What is the future of corporate environmental performance expectations? What dimensions will be added in the coming years to current issues that companies track?

There are an increasing number of signals that a ‘game changing’ paradigm shift is underway with the potential to significantly expand stakeholder expectations. (For details, see sidebar on previous page as well as BSR’s past reports on environmental services at www.bsr.org/research/reports.) Although the exact timing and geographic locations of uptake remain uncertain, the trend is becoming clear.

Environmental issues are broadening from a discrete, single-issue management approach to one that includes considerations of how business may be affecting landscape-level ecological dynamics, such as the flows of ecosystem services.¹

Indications of this paradigm shift—from a siloed, single environmental issue approach to a systems-based approach—are evident in the U.S. Environmental Protection Agency’s orientation of its research agenda to ecosystem services,² as well as the European Environment Agency’s investments in ecosystem services research and decision aids.³ Business schools, such as Stanford University in the United States and FGV in Brazil, are building ecosystem services into the curriculum. In addition, according to a December 4, 2009 *Newsweek* article, the coupling of ecosystem services with the language of finance is now a “mainstream practice.”

As ecosystem services concepts broaden environmental thinking, it is likely that expectations of corporate performance will similarly expand. For example, if trends play out, stakeholders may demand that corporate reporting include not only specific trends—such as corporate greenhouse gas emissions, water usage, and other parameters—but also information that contextualizes company-specific data within the broader watershed, landscape, or regional dynamics. One signal that a change in reporting expectations could be underway is the Global Reporting Initiative’s consideration of ecosystem services as one of its new areas of focus in 2010.⁴

For advocates of expanding corporate environmental performance expectations, the rationale is that improvements in individual parameters are still problematic if they are occurring within the context of overall disintegration of ecosystem structures and functions. Therefore, ecosystem services advocates call for not only understanding particular environmental impacts, but also interpreting those impacts in terms of broader ecological dynamics that factor in ecosystem structure, function, and flows of services.

In response, corporate leaders have begun to make ecosystem-services-related commitments and develop new practices. For example, the Walt

1 For a more in-depth treatment of how ecosystem services concepts apply to business management, see BSR’s report “[The New Markets for Environmental Services: A Corporate Manager’s Resource Guide to Trading in Air, Climate, Water, and Biodiversity Assets](#).”

2 www.epa.gov/ecology/

3 A few illustrative examples include: www.eea.europa.eu/publications/briefing_2008_2 and [www.iiisci.org/journal/CV\\$/sci/pdfs/M567EH.pdf](http://www.iiisci.org/journal/CV$/sci/pdfs/M567EH.pdf); www.pik-potsdam.de/ateam/

4 www.globalreporting.org/NewsEventsPress/LatestNews/2009/NewsJuly09NewG3Projects.htm

Emerging Questions for Companies

- » Have you assessed your reliance on ecosystem services, whether these demands are sustainable, and potential alternatives?
- » Do you have adequate information on the current and projected state of these ecosystem services over the timeframes relevant to your business?
- » Have you evaluated the potential for nonlinear changes in services on which your business or suppliers depend?
- » Do you have any programs or plans to minimize impacts on ecosystems or contribute to maintenance and enhancement of ecosystem services?
- » Do you have the diversity of expertise that you need to manage these issues?

Disney Company has asserted that it will have “net positive impacts on ecosystems.”⁵ Similarly, Rio Tinto has a goal of a “net positive impact on biodiversity,” which the company defines as including ecosystems.⁶ Other companies, such as Syngenta, are exploring methods in which on-the-ground practices may be consonant with ecosystem services, such as farming in ways that support vegetation essential for pollinating species.⁷

As companies make ecosystem services commitments, there will be increasing need for the identification, measurement, assessment, and potentially even valuation of both impacts and dependencies on ecosystem services within the landscapes in which businesses operate. Such an evolving mandate could emerge through voluntary corporate commitments, new regulations, or simply become standard practice expected by activists, investors, and other stakeholders.

For investors, in particular, the issue may become one of risk management and ensuring that they are engaged in due diligence that highlights both traditional and emerging issues related to ecosystem services. For example, have companies reliant on drawing water from underground aquifers examined natural recharge rates? What is the likelihood that these aquifers will continue to have water needed on a five-, ten-, and even twenty-year time frames? If not, is there a risk of a significant stranded asset that is reliant on water for continuing to operations?

If interest in ecosystem services issues continues to build among stakeholders, investors, and regulators, then corporate decision-makers will need to understand where, how, and in what ways ecosystem services concepts can be incorporated into existing corporate decision-making processes.

An increasing number of tools exist, or are in development, to assist decision-makers with these measurement issues. The ecosystem services tool landscape has expanded quickly, with a series of tools released in beta version in 2008 and even more in development today. The result is an increasingly complex tools landscape that covers the gamut in terms of target audiences, intended uses, scope, level of detail, cost of application, and other parameters.

The proliferation of tools has made it difficult to select which to consider in more detail or even to test in pilot applications. Many uncertainties remain, including costs and benefits of application and the ideal applications of the tools within existing corporate decision-making processes. In part, these questions stem from a context in which few tool developers have focused on business decision-makers or have systematically engaged in discussion with corporate decision-makers about their interests in desirable attributes of such tools. The tools that have focused on corporate contexts have yet to offer independent reviews of the applications to date in terms of “value add” within business decision-making.

⁵ <http://disney.go.com/crreport/environment/ourcommitments/ecosystems.html>

⁶ “To Rio Tinto, biodiversity refers to the variety of life on earth, the different animals, plants, and microorganisms, their genes, and the ecosystems of which they are a part.” (www.riotinto.com/documents/RT_and_biodiversity_brochure.pdf)

⁷ <http://operationpollinator.com/>

Current Status of the Ecosystem Services Tools Domain

The ecosystem services tool domain is still emerging. None of the ecosystem services tools are fully mature and independently reviewed, or validated, in terms of an assessment of corporate applications. Rather, some tools have been applied, but no public information released on lessons learned from these tests. Other tools sit along a spectrum from being in development, through a “pre-release” phase, to having “beta” versions. Most of the tools have been or will be issued soon—either in their entirety, in a draft/beta version, or as illustrative modules of the fuller tool.

A new set of integrated, multi-ecosystem services tools is emerging,⁸ following on years of work. These new tools are in addition, and complementary to, a growing set of single environmental issue-focused tools, such as related to carbon/greenhouse gases, water, and biodiversity. Both tool sets offer new ways for corporate decision-makers to begin understanding their ecosystem services impacts and dependencies—either one ecosystem services at a time or considering the full set of landscape-level dynamics.

The new, emerging first generation of multi-ecosystem service tools is focused on evaluating and assessing a myriad interacting, and often interdependent, ecological parameters using an ecosystem services “flows” approach. There are a number of crosscutting characteristics among tools, including:

- » **scalable data, resource, and time demands**, so that decision-makers can use either existing or default data, or put in whatever level of effort is feasible in terms of their own staff time to undertake the analysis
- » **a focus on ease of use**, either through computer models or a series of tasks within an overall analytical approach

Despite some areas of resonance across tools, there are a number of key distinctions between the tools, including:

- » **user “interface,”** which span from computer models through workbook-like excel spreadsheets
- » **type of results**, ranging from strategic issue lists through spatially explicit maps that show changes in ecosystem services with different land-management decisions
- » **data demands**, from high to low, spanning from do-it-yourself to detailed, pre-loaded databases
- » **ecological detail/emphasis**, including high-level/coarse-grain assessments through fine-grain, map-based assessments
- » **valuation emphasis**, which can be further parsed in terms of value within an existing environmental market or value within a broader societal context that draws upon ecological economics theory

The most corporate-relevant multi-ecosystem services tools are listed in table 1, with a series of figures that illustrate the current state of the field, potential corporate applications, and possible complementarities among tools. (A number of other relevant marine tools are listed in Annex 2.) While a full comparative assessment is difficult given that few of the tools have been tested and independently validated, a preliminary snapshot of the tool landscape—in terms of key parameters identified by the working group—is provided in Table 2.

⁸ These multi-ecosystem services tools, from around the world, were identified through both desk research and semi-structured interviews. All tools identified were examined, through online modules (if possible), peer-reviewed articles (where available), as well as through any other existing materials. The developers of corporate-relevant tools were contacted through email and telephone for further information. The result of this research is a list, enumerated in the table that follows, of the most corporate-relevant emerging tools that seek to consider multiple ecosystem services concurrently. (A few tools are in development as doctoral dissertations, without any plans for post-research, broad-based dissemination. Similarly, other tools have been developed, but are not being maintained or made easily available. These tools are omitted from the list, as they are not broadly available. However, the tools will be tracked, and changes will be included in future assessments.)

Table 1. Corporate-Relevant, Multi-Ecosystem Services Tools

Tool	Brief Overview	Creators
Globally Relevant		
<p>ARIES (Artificial Intelligence for Ecosystem Services) http://esd.uvm.edu/ http://ecoinformatics.uvm.edu/aries</p>	<ul style="list-style-type: none"> » A web-based, artificial-intelligence-enabled, decision-support system for assessment and valuation of ecosystem services that “studies” all of the data relevant to ecosystem services assessment questions in a given area and constructs a cause-and-effect picture of how ecological and economic factors interact. Users can explore effects of policy changes and external pressures (such as climate change) through a scenario analysis module. Incorporates a valuation module to assess potential and realized economic values, as well as a biodiversity module to estimate values of protected areas for human well-being and threats to protected species. » Result of an ARIES user session is a dynamic environmental asset analysis that spatially quantifies the provision, use, and dynamics of flow of ecosystem services in the area as well as citations for all operations, datasets, and models used. » A fully functional portal will be available in 2010, though test versions are currently available. 	<ul style="list-style-type: none"> » University of Vermont, Gund Institute for Ecological Economics » Conservation International » Earth Economics Institute
<p>ESR (Corporate Ecosystem Services Review) www.wri.org/project/ecosystem-services-review</p>	<ul style="list-style-type: none"> » The ESR is a structured methodology for corporate managers to proactively develop strategies for managing business risks and opportunities arising from their company’s dependence and impact on ecosystems » Available free online through an excel spreadsheet and supporting materials. » In addition, an ‘Ecosystem Services for Corporate Decision Making’ project has been launched to assist corporations integrate ecosystem services into ISO standards (e.g., 14001), the Global Reporting Initiative, and the Global Compact’s Performance Model. Parallel efforts for integrating ecosystem services into other business models (e.g., life cycle assessments, environmental impact assessments, product development) are ongoing. 	<ul style="list-style-type: none"> » Co-developed by World Resources Institute (WRI), World Business Council for Sustainable Development (WBCSD), and the Meridian Institute
<p>EVI (Ecosystem Valuation Initiative) www.wbcscd.org/Plugins/DocSearch/details.asp?DocTypeId=251&ObjectId=MzQ0ODk</p>	<ul style="list-style-type: none"> » Building on the ESR assessment platform, the WBCSD has launched an Ecosystem Valuation Initiative (EVI) to extend the scope to include quantification of ecosystem risks and opportunities by providing guidance to companies on accounting for appropriate ecosystem benefits and costs. An advocacy document has been issued, which makes the case for integrating valuation into corporate decision-making, and a guide will be issued in October 2010. » The EVI is linked to the TEEB (The Economics of Ecosystems and Biodiversity) project, which was initiated by the G8 + 5 Environment Ministers (Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States + Brazil, China, India, Mexico and South Africa) in 2007. 	<ul style="list-style-type: none"> » An initiative of WBCSD, with WRI, PwC, ERM, and IUCN as a supporting organizations
<p>InVEST (Integrated Valuation of Ecosystem Services and Tradeoffs) www.naturalcapitalproject.org/InVEST.html</p>	<ul style="list-style-type: none"> » InVEST is a tool to model and map the delivery, distribution, and economic value of life-support systems (ecosystem services) well into the future, available through ARC GIS » It helps users visualize the impacts of potential decisions, identifying tradeoffs and compatibilities among environmental, economic, and social benefits 	<ul style="list-style-type: none"> » The Natural Capital Project: Stanford University, WWF, The Nature Conservancy (TNC)

Geographically Limited Tools (with methodologies that could be adapted)

<p>EcoAIM (Ecological Asset Information Management) www.exponent.com/</p>	<ul style="list-style-type: none"> » A tool to quantify and value ecosystem services by evaluating chemical, biological, and physical characteristics of a specific site, with free / publicly available data and ‘ground truthing’ only when required » Provides relative ranking of land within a watershed or regional landscape, with spatially explicit outputs and scenario building capabilities » Developed for use in the United States with U.S. data 	<ul style="list-style-type: none"> » Exponent
<p>EcoMetrix www.parametrix.com/cap/nat/_ecosystems_ecometrix.html</p>	<ul style="list-style-type: none"> » A multi-resource debit / credit tool for estimating the type and number of ecosystem credits available on a given site, including multiple types of credits—including, but not limited to, wetland habitat or carbon sequestration—in order to consider all of the critical ecological functions on a given site » EcoMetrix is ultimately a mechanism to measure changes and reward landowners for benefits that result from their conservation efforts and expenditures » Developed for use in the United States 	<ul style="list-style-type: none"> » Parametrix
<p>MEASURES (Model Ecosystem Services Credit Calculator) www.rregion.org/pdf/vapdc/env_cmte/E_COSYSTEM.SERVICES.VADOF.1.30.09.pdf</p>	<ul style="list-style-type: none"> » A modular model that links credit calculators—currently for carbon, water, and biodiversity—in order to enhance landowner participation in emerging ecosystem service markets, enable smart landscape planning, and create incentives for corporate environmental stewardship as commercial and residential needs grow » Emerged in relation to the Virginia governor’s interest in increasing land in an easement program » Model still in development, though only available for the U.S. state of Virginia 	<ul style="list-style-type: none"> » Virginia Department of Forestry » Virginia Tech
<p>SERVIR www.servir.net</p>	<ul style="list-style-type: none"> » A regional visualization and monitoring system for Mesoamerica and Africa that integrates satellite and other geospatial data for improved scientific knowledge and decision-making 	<ul style="list-style-type: none"> » USAID, NASA, IAGT, University of Colorado, CATHALAC
<p>Wildlife Habitat Benefits Estimation Toolkit www.defenders.org/programs_and_policies/science_and_economics/conservation_economics/valuation/benefits_toolkit.php</p>	<ul style="list-style-type: none"> » Easy-to-use, spreadsheet-based valuation models, tables, and databases directed at land-use and wildlife planners and others interested in estimating the economic benefits associated with wildlife and habitat conservation in specific regions » Includes models that generate estimates of: (1) annual values for ecosystem services provided by terrestrial and aquatic habitat or wetlands; (2) open-space property value premiums; (3) net economic benefits per activity day for participation in wildlife-associated recreation activities (fishing, hunting, wildlife watching); (4) visitation numbers for wildlife-associated recreation for an existing wildlife refuge or state game management area, or changes in visitation from the expansion/reduction of the acreage on such lands, as well as statewide visitation numbers for other conservation acreage that provides for wildlife-associated recreation activities » Available free online, but only for the United States 	<ul style="list-style-type: none"> » Colorado State University, Department of Agricultural and Resource Economics » Defenders of Wildlife

Investor-Focused		
<p>NVI (The Natural Value Initiative)</p> <p>www.naturalvalueinitiative.org/content/003/303.php</p>	<ul style="list-style-type: none"> » Enables the finance sector to: (1) evaluate how well the food, beverage, and tobacco sectors are managing biodiversity and ecosystem services risks and opportunities; and (2) engage the companies to reduce their risk exposure by reducing impact on biodiversity and ecosystem services, through the responsible management and harvesting of natural resources » Consists of the Ecosystem Services Benchmark (ESB) tool and associated guidance material for investors » Evaluates the extent to which companies have systems in place that adequately identify and control material business risks associated with company dependency and impacts on ecosystem services 	<ul style="list-style-type: none"> » Flora and Fauna International » UNEP FI » Brazilian business school FGV

Table 2. Comparative Snapshot of the Ecosystem Services Tool Landscape

Understanding the Tools	<ul style="list-style-type: none"> » Objectives: All tools seek to improve decision-making through the inclusion of ecosystem services considerations, though some tools focus on identifying and valuing ecosystem services, while others focus on targeting environmental markets that could be tapped into at a specific site potential » Intended users: <ul style="list-style-type: none"> - The ESR, EVI, EcoMetrix, EcoAIM, and NVI have companies as their core focus - Other tool developers are very interested in engaging with the private sector
Considering Analytical Parameters of Tool	<ul style="list-style-type: none"> » Ecosystem services included: Most tools use the MEA categories or variations thereof » Ecosystem services (or ecological systems) omitted: Marine / ocean components are either non-existent for many tools or in development with modules to be released in 2010 (ARIES and InVEST)
Assessing Data Requirements, Quality, and Costs of Application	<ul style="list-style-type: none"> » Data and time requirements: Most tools are scalable in terms of data needed, simply decreasing certainty with little data » Capability for technologies to feed data into the tool: Simple, direct feeds do not currently seem to exist for any tools, although InVEST and EcoAIM both work within ARC GIS, which allows for data meshing within that software. Similar approaches may evolve for other tools as their platforms evolve
Accessing the Tool	<ul style="list-style-type: none"> » Tool availability: A number of tools will be available online—with most being available at nominal costs or free (though pricing for the private sector players is at a “to be determined” stage for some tool developers). Costs of engaging with consulting firm tools (EcoAIM and EcoMetrix) is also to be determined. » The ESR is available for free in 6 languages

	<p>Engagement with tool developers:</p> <ul style="list-style-type: none"> » Only the environmental consulting firms are creating the tool with the intention of requiring work with the developer, though the type and cost of engagement will vary. » The other tool developers intend the user to apply the tool on their own. However, training may be helpful for application (named by InVEST) as well as to ensure quality control (named by ESR), which could lead to training programs being offered by tool developers. (This application context is similar to other tools, such as green house gas protocols.) » For some tools, training is already underway. For example, the ESR has trained about 40 consultants, who are listed on the WRI website, and additional trainings are planned for in 2010 in France and China.
Assigns Values to Ecosystem Services?	<ul style="list-style-type: none"> » Yes—valuation is available in ARIES, InVEST, EVI, EcoAIM, EcoMetrix, MEASURES, and the Wildlife Habitat Estimation Toolkit » Possible, but not a focus (ESR) as other tools can be used to infuse these values (qualitative or quantitative) » Not possible/not built into tool (NVI)
Exploring Stakeholder Engagement	<ul style="list-style-type: none"> » While some tools are being piloted within multi-stakeholder contexts (ARIES and InVEST), specific guidelines on these issues have not yet been publicly issued.
Applying within Existing Corporate Processes	<ul style="list-style-type: none"> » Designed to fit within corporate EMS' and/or EIAs: <ul style="list-style-type: none"> - Possible for future work (ESR), with current work focused on meshing the ESR with ISO, GRI and the Global Compact's Performance Model - Not in current or near-term plans for other tools
Identifying Assumptions	<ul style="list-style-type: none"> » Assumptions underlying approach and methodology: <ul style="list-style-type: none"> - Cover a range for all tools
Exploring Broad-Based Application	<ul style="list-style-type: none"> » Subject matter expertise needed: All assume knowledge of ecological issues, with some requiring technical skills (e.g. GIS) or access to an expert (such as sourced from the Ecosystem Services Experts Directory, which is a joint effort of WRI, IUCN, EarthWatch, WBCSD, and ESA and available online) » Challenges found in tool uptake: While early lessons exist, it is premature to fully assess
Understanding the Value Proposition	<ul style="list-style-type: none"> » Business case for corporate use of this tool: <ul style="list-style-type: none"> - High-level, general, cross-industry (ESR, NVI, and the WBCSD EVI publication "Corporate Ecosystem Valuation – Building the business case" http://www.wbcscd.org/DocRoot/sTRJLXdoq8SPdrVilYHq/CorporateEcosystemsValuation-BuildingTheBizCase.pdf) - Not in current or near-term plans for all of the other tools

Given the emergent nature of the ecosystem services tool domain, as well as the lack of independent assessment of corporate tool applications to date, it remains challenging to map the field and understand complementarities and distinctions across the tools. Yet based on the currently available information, it appears that tools could play slightly overlapping, but predominantly complementary roles in different phases of decision-making, including:

PHASE 1: 'GATEWAY' TOOL FOR ASSESSING CORPORATE RELEVANCE OF ECOSYSTEM SERVICES

The **ESR** could provide an introduction to ecosystem services issues and a high-level issue identification exercise that can also result in specific strategic actions.

For more advanced corporate audiences, an initial focus on spatially explicit mapping may be appropriate, through **ARIES** and/or **InVEST**. Alternatively, if so desired, efforts could shift right away to a focus on site-specific valuation (phase 3 tools).

PHASE 2: TOOLS FOR SPATIALLY EXPLICIT MAPPING OF ECOSYSTEM SERVICES FLOWS IN A PARTICULAR LANDSCAPE OR WATERSHED(S)

ARIES and **InVEST** offer two distinct approaches to spatially explicit modeling of ecosystem services flows. Both tools allow for assessing scenarios and ecosystem-service-related pros and cons associated with potential future actions.

The key distinction is that **InVEST** focuses on site-specific data on natural and built capital and widely agreed upon equations associated with ecological dynamics (e.g., water filtration) to allow the user to forecast effects of potential decisions. **ARIES** takes a probabilistic approach—in which if there is less data and site-specific information then the results will reflect higher uncertainties—that is combined with 'computer learning' or an artificial intelligence approach that enables the model to become more finely tuned as computations are run.

PHASE 3: TOOLS FOR 'FINE GRAIN' SITE ASSESSMENT AND VALUATION OF ECOSYSTEM SERVICES

EcoAIM provides a GIS-linked web-tool that can access data in real time to assess ecological "assets" on a specific parcel. (Note that this tool is only applicable at this time to the United States and may be difficult to adapt in contexts with limited data.)

EcoMetrix offers a rapid-assessment protocol for an ecologist to conduct on-site assessments of ecosystem services by looking for key parameters that can be input into a model for identification of potential environmental markets relevant to a site. (Note that this tool is only applicable at this time to the United States, but the on-the-ground protocol could be adapted globally with sufficient time and resources. The environmental markets software would only be relevant in countries where there are multiple environmental markets established.)

Ecosystem Valuation Initiative (EVI) will issue a corporate guide to ecosystem valuation—following 'road-testing' with 10-15 WBCSD member companies—in October 2010.

MEASURES provides a rapid assessment of relevant environmental markets for a specific land parcel based on remote sensing data. (Note that this tool is currently only being developed for the U.S. state of Virginia, but the methodology could be adapted globally due to its reliance on remote sensing data.)

The **Wildlife Habitat Estimation Toolkit** could be used for valuing the economic benefits associated with wildlife and habitat conservation in specific geographic

regions. (Note that this tool is only applicable at this time to the United States and may be difficult to adapt in contexts with limited data.)

This potential phased approach to application—which represents a series of specific niches for, and complementarities between, tools—is illustrated in the figures that follow.

Figure 1. Emerging Ecosystem Services Tools Domain and Potential Future Complementarities Among Ecosystem Services Tools

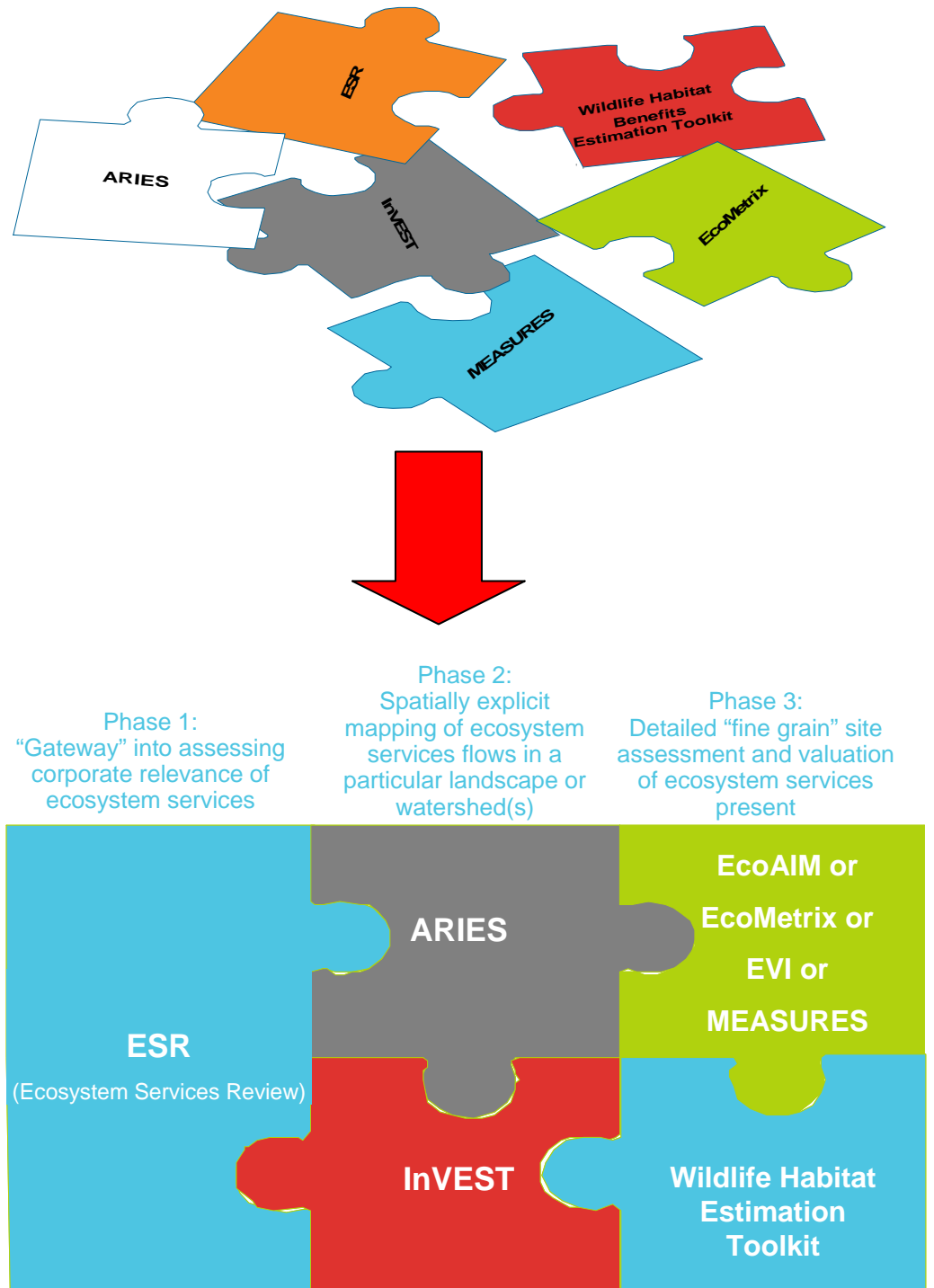


Figure 2: Potential Applications of Ecosystem Services Tools

Tools for:

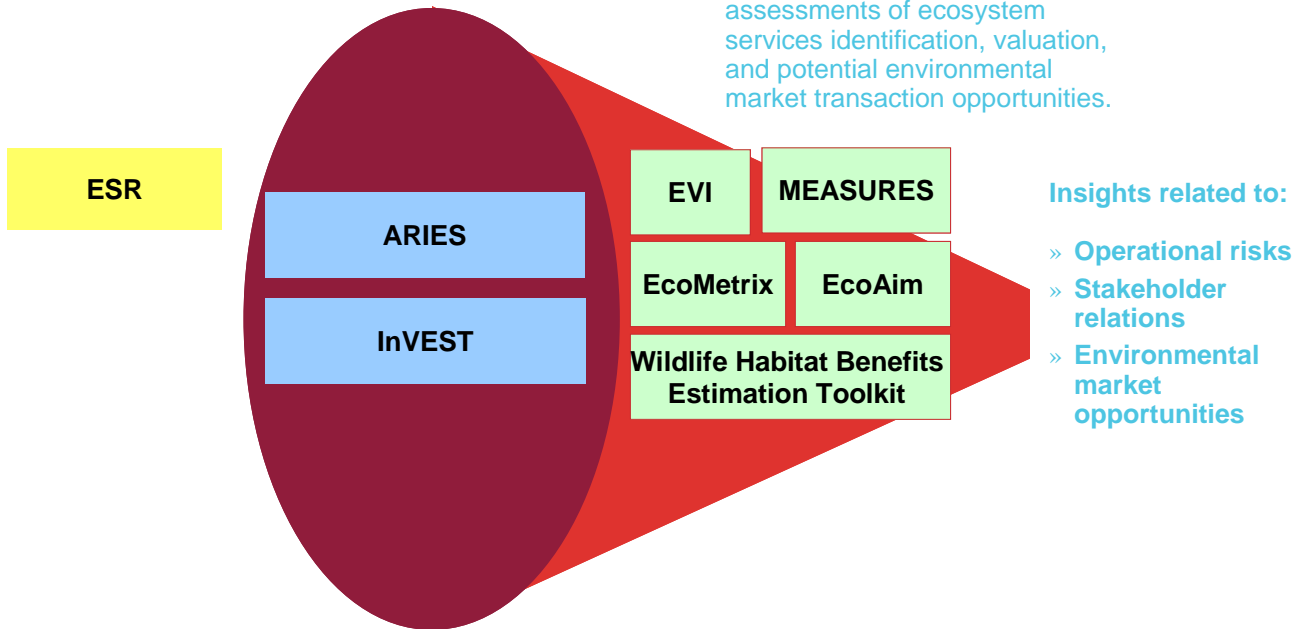
- » introducing ecosystem services concepts
- » conducting relatively rapid desk reviews for understanding ecosystem impacts and dependence

Tools for:

- » considering options/scenarios in terms of landscape-level ecosystem services flows, such as siting within a watershed basin (or sub-basin)

Tools for:

- » conducting parcel-level assessments of ecosystem services identification, valuation, and potential environmental market transaction opportunities.



The tools could also, of course, be used more selectively, such as through examination of overall ecosystem services impacts and dependencies (phase I) and then shifting focus to detailed valuation (phase III), without pursuing the spatially explicit mapping approach if that is not desired. Similarly, corporate decision-makers could decide to identify issues and opportunities (phase I) and then develop a spatially-explicit assessment (phase II), without moving to a valuation phase.

The question is what is most relevant to the corporate decision-making context and existing process. That is, how do these tools could mesh with pre-existing corporate decision-making processes?

»

Integrating Ecosystem Services Tools within Corporate Decision-Making Processes

While every business is unique, most large companies engage in decision-making around corporate governance, strategy, and operations, as illustrated in Figure 3. These broad categories have subcomponents, as laid out in Figure 4, that have varying degrees of promise as potential interface points with ecosystem services tools, as described in Table 2.

To assist both tool developers and corporate decision-makers, the supplementary materials document includes a series of tables that illustrate company activities within each decision category. These tables also highlight likely interface points with ecosystem services, potential for application of ecosystem services tools, and desired tool attributes for the specific application. Particular attention is given to major capital projects, as they are typically some of the most significant areas of potential ecosystem service related risk and opportunity for companies.

Figure 3. Generalized Key Corporate Decision Categories



Figure 4: Illustrative Corporate Decision Categories and Subcomponents

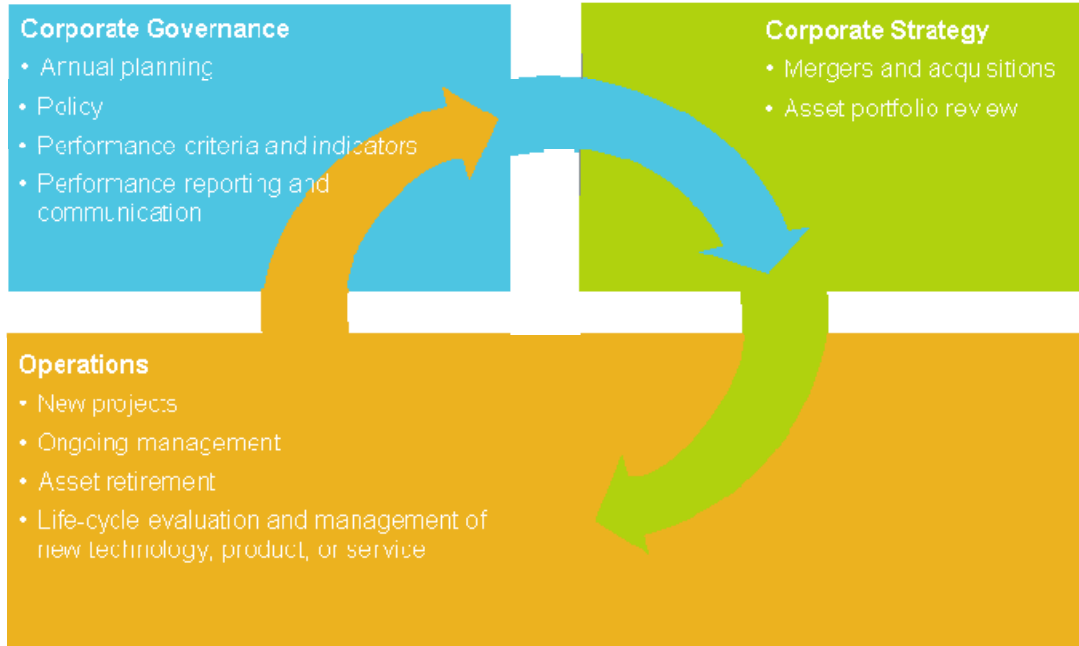


Table 3. Generalized Needs for Ecosystem Services Tools for Corporate Decision-Making

Corporate Governance	Corporate Strategy	Business Operations
<p>» Provide performance criteria that integrate ecosystem services considerations into environmental and social governance as well as management systems</p>	<p>» Offer insights into risks and opportunities associated with high-level decisions around strategic business opportunities, such as:</p> <ul style="list-style-type: none"> - comparative evaluations of potential competing new projects or rationalization of the company’s land-holding portfolio, and - assessments of possible investments, such as, in a new technology, product, or service 	<p>» Identify relationships on the ground between investments/assets, ecological structure and function, and local community needs and interests, such as for:</p> <ul style="list-style-type: none"> - new projects’ baseline and impact assessments, including selecting among key alternatives (locations, technologies, etc.) and monitoring impacts over time; - operations’ periodic risk assessments; - decommissioning / closure decision-making for identification of the best potential future use of property, and defining objectives for and carrying out site remediation; and - life-cycle evaluation and management of new technologies, products, or services <p>» Assess new positive opportunities associated with ecosystem services, such as obtaining revenue or reputation benefits through ecosystem services enhancement.</p>

In the short term, new project developments may hold the most promise for ecosystem services tools since these new projects can:

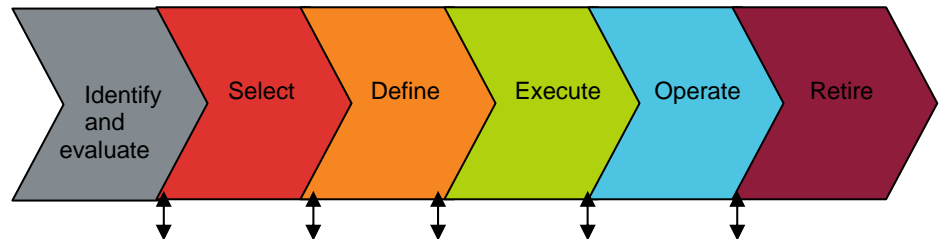
- » have significant potential for impacts on ecosystem services
- » raise important risks and opportunities for the company relating to ecosystem services
- » involve key choices among options regarding major aspects of project viability, location, design, execution, operation, and preparation for eventual asset retirement

Box 1: Corporate Tool Needs

- » Integration of ecosystem services issues into risk and impact assessments
- » Internalization of ecosystem services considerations into project and other business economics
- » Identification of opportunities to benefit from ecosystem services

Many companies plan and execute major capital projects within a general conceptual framework of a project “life cycle.” The figure below suggests a generic representation of project life-cycle phases that most companies recognize and use in their project-planning processes.

Figure 5: Generic Corporate Project Life Cycle



“Phase gate” decision points include: to proceed with project (with/without conditions), hold or drop, or recycle for further information and review.

Many companies also typically use a formal, structured decision-making process to plan and execute major capital projects (as well as for a variety of other company activities). The process typically provides some assurance that management will have appropriate information for evaluation to make informed decisions about project risks and benefits before formally authorizing the project to move through the “gate” from one phase to the next. An environmental, social, and health impact assessment is typically the most common and important part of the process. Impact assessments can be driven by internal or external requirements (e.g. corporate policy, government regulation, or third-party finance institution).

The earliest stages of the project life cycle—identify, evaluate, and select—offer the greatest scope for consideration of ecosystem services and the use of ecosystem services tools. Scope for impacts/opportunity identification and for choices among options on avoidance/mitigation becomes narrower and more focused as the project moves into detailed design, execution, and initial start-up of operations. Detailed tables in the supplementary materials document offer an illustrative characterization of new project phases and activities. Detailed information from specific industry sectors and individual companies is essential for a more complete and nuanced picture.

Finally, from corporate governance through strategy and operations, each of these corporate decision categories is likely to require distinct tools with different attributes. Therefore, as company decision-making activities move from broad corporate governance through strategic business evaluations and on to operationally focused, on-the-ground activities, the tools needed will similarly shift from being high-level conceptual and process oriented to geographically specific and data driven.

Within this context, a company will need a suite of tools to identify issues that are not currently ‘captured’ within existing decision-making processes and activities around environmental and social issues (e.g. environmental and social impact assessments for new projects). Any new ecosystem services tools and their outputs will need to easily interface with existing corporate decision-making processes as well as have a high degree of ease of use and credibility.

Box 1 identifies several high-level ways BSR working group members feel ecosystem services tools would be most useful to companies in the near term. These potential pathways forward reflect a focus on operational activities.

Box 2: Desired Tool Capabilities

- » Identify what and where specific ecosystem services are being generated and used.
- » Understand the underlying ecosystem functions from which the services arise.
- » Assess how those services will change over time (naturally, and in response to company and other human activities).

This current operational focus for the use of ecosystem services tools does not discount the value companies perceive in having tools for strategic business and governance activities, given their role in overall corporate performance as well as in business opportunities and risks. Therefore, companies see a longer-term need for tools that can inform and support these decision-making activities.

Boxes 2 and 3 highlight some key tool capabilities and attributes seen by corporate representatives as most critical for successful tool uptake in the private sector. The supplementary materials document contains a detailed discussion of tool capabilities and attributes.

These potential interface points and attributes are intended to help tool developers design and evaluate their tools, while also assisting companies to select and assess the usefulness of individual tools for specific corporate applications. Ideally, the ideas will be tested in the coming years within an increasing number of corporate settings as the concepts, tools, and business case for application more fully emerge.

Box 3: Key Tool Attributes for a Business Audience

- » **Scalability and adaptability** for many different geographic locations, site-specific conditions, type and level of company activity, time periods, and more
- » **Ability to generate and compare scenarios** relating to company activities, future ecosystem changes, etc.
- » **Ease of use** (including time and resources)
- » **Generation of spatial display of information** (e.g. maps)
- » **Transparency**—easy to understand and communicate tool inputs, operation, and outputs to company personnel and external stakeholders (no “black boxes”)

Concluding Thoughts

Potential Business Benefits of Applying Ecosystem Services Tools to Corporate Decision-Making Processes

- » Reduction of risks and adverse effects on ecosystem services through detailed models that seek to draw upon multiple parameters in the Millennium Ecosystem Assessment and allow for scenario-based planning
- » Exploration of environmental market engagement through credit calculators and tools focused on enabling land owners to assess potential environmental markets for which they may qualify to sell credits

As the environmental management paradigm expands to add a new dimension—that of ecosystem services—the question for corporate decision-makers becomes if and when to add new parameters to existing protocols. The key questions to ask are outlined below.

“If”: Should your company adopt ecosystem services tools?

- » Are there market, or other operating, conditions that make ecosystems-level assessments critical to your company?
- » How comfortable is senior management with piloting assessment tools when no clear standardized guidelines exist?
- » What investments would your company make in data collection versus partnering with NGO or academic partners on the ground?

“When”: At what point should tool adoption occur?

- » What are the trends projected for the market or operating conditions mentioned above?
- » Can the case be made to management that positioning yourself now will benefit you once the field crystallizes?

“How”: What is the process for meshing new tools/assessment protocols with existing corporate decision-making processes?

- » Have you conducted a gap analysis of existing internal processes and reporting tools (e.g. environmental impact assessment, biodiversity action plan) to gauge your company's current effectiveness in identifying ecosystem service-related issues?
- » Have you assessed the necessary skills and expertise for identifying and assessing ecosystem services? Do you have these skills/this expertise in-house?
- » Have you specified your objective in applying tools? What selection criteria should you adopt? Do these criteria include cultural issues, such as a corporate focus on quantitative over qualitative data/tools?
- » What are the key existing decision-making processes/points at which you feel that the tools would be most productively applied?

Corporate decision-makers will need to consider the rigor, feasibility, and costs associated with assessing new environmental factors, particularly within contexts where few experts exist and data are sparse. Within this context, corporate representatives can begin to ask if and when they would utilize emerging ecosystem services tools.

In cases where corporate representatives conclude that it would be productive to apply ecosystem services tools, then the question quickly becomes how to integrate new components within pre-existing decision-making processes. The first step will be to gain clarity on existing decision types and decision-making processes.

Our hope is that this document can play a role in deepening the discussion around all of these issues within the emergent ecosystem services domain.

Annex 1: Individuals Contacted in Tools Assessment Process

Organizations	Name
Tool Developers	
ARIES	<ul style="list-style-type: none"> » Ferdinando Villa, University of Vermont, Gund Institute for Ecological Economics » Marta Ceroni, University of Vermont, Gund Institute for Ecological Economics » Miroslav Honzák, Conservation International » Dave Batker, Earth Economics Institute
ATEAM	<ul style="list-style-type: none"> » Dagmar Schroeter, International Institute for Applied Systems Analysis
EcoAim	<ul style="list-style-type: none"> » Pieter Booth, Exponent » Sheryl Law, Exponent
EcoMetrix	<ul style="list-style-type: none"> » Kevin Halsey, Parametrix » Kevin Benck, Parametrix » Damon Hess, Parametrix
Entrix	<ul style="list-style-type: none"> » Doug MacNair, Entrix » Ramona Swenson, Entrix » Ann Redmond, Entrix
ESR and EVI	<ul style="list-style-type: none"> » John Finisdore, World Resources Institute » James Griffiths, World Business Council for Sustainable Development
InVEST	<ul style="list-style-type: none"> » Gretchen Daily, Stanford University » Heather Tallis, Stanford University » Buzz Thompson, Stanford University » Nirmal Bhagabati, WWF » Emily.McKenzie, WWF » Kari Vigerstol, The Nature Conservancy
MEASURES	<ul style="list-style-type: none"> » Randolph Wynne, Professor of Forestry and Remote Sensing, Virginia Tech
NVI	<ul style="list-style-type: none"> » Annelisa Grigg, Flora and Fauna International » Jason Sali, Flora and Fauna International
Wildlife Habitat Benefits Estimation Toolkit	<ul style="list-style-type: none"> » Timm Kroeger, Defenders of Wildlife » Frank Casey, Defenders of Wildlife
Crosscutting	
Ecosystem Services Assessment and Valuation Project	<ul style="list-style-type: none"> » Silvia Silvestri, UNEP – World Conservation Monitoring Centre
University of Venice and Fondazione Eni Enrico Mattei (FEEM)	<ul style="list-style-type: none"> » Paulo Nunes, Professor of Environmental Valuation, Department of Economics, University of Venice; Senior Economist, Fondazione ENI Enrico Mattei, Biodiversity and Sustainable Economics

	Division
Government	
U.S. EPA's Office of Research & Development	» Iris Goodman, Deputy National Program Director for Ecology
USDA's Office of Ecosystem Services and Markets	» Carl Lucero, Deputy Director
U.S. Geological Survey	» Carl D. Shapiro, Senior Advisor for Science, Decisions, and Policy
U.S. Department of the Interior	» Malka Pattison, Office of Policy Analysis
European Environment Agency	» Manuel Winograd, Advisor on Socio-Ecological Dynamics and Vulnerability

Annex 2: Additional Relevant Coastal and Marine Tools

Coastal and Marine Tools		
Habitat Priority Planner www.csc.noaa.gov/digitalcoast/tools/hpp/index.html	<ul style="list-style-type: none"> » Aids in making decisions about habitat conservation, restoration, and land-use planning » Provides means of obtaining critical habitat analyses that are consistent, repeatable, and transparent » Allows users to easily test various ideas and "what if" scenarios on the fly, making it the perfect tool to use in a group setting 	<ul style="list-style-type: none"> » NOAA Coastal Services Center
Future Scenarios Mapper Tool for Coastal Ecosystems http://coastalresilience.org/future-scenarios.html	<ul style="list-style-type: none"> » Provides communities with easy access to information for coastal planning, zoning, acquisition, and other management decisions regarding resources at risk from sea-level rise and coastal hazard » Provides an interactive, web-mapping tool that enables users to visualize future flood scenarios; determine ecological, social, and economic impacts caused by sea-level rise and storm surge; and conduct policy analysis of possible solutions » Focus is on the south shore of Long Island, New York » Methodology is readily transferable to other locations 	<ul style="list-style-type: none"> » The Nature Conservancy
Integrated Land-Sea Planning Toolkit www.communityviz.org www.natureserve.org/vista www.csc.noaa.gov/digitalcoast/tools/nspect/	<p>Comprised of three tools:</p> <ol style="list-style-type: none"> 1 CommunityViz for land-use planning/growth modeling (www.communityviz.org) 2 NatureServe Vista for conservation assessment and planning (www.natureserve.org/vista) 3 NOAA's N-SPECT (www.csc.noaa.gov/digitalcoast/tools/nspect/) for non-point-source-pollution modeling <p>The toolkit is intended to facilitate collaborative assessment and planning by evaluating the water quality and subsequent ecological/biodiversity impacts of various land-use scenarios in freshwater, terrestrial, and (with additional tools) marine ecosystems. The toolkit interoperation was developed and tested on the U.S. coast off the state of Texas, and an initial practitioner training was conducted. Shortly, the biodiversity component of this, Vista with N-SPECT, will be shipped as a semi-automated, interoperating toolkit (as NatureServe Vista 2.5). Both of those tools are free ESRI extensions.</p>	
Marine Spatial Planning Tool www.unesco-ioc-marinesp.be	<p>A process-driven approach to analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives. A well-conducted MSP can:</p> <ul style="list-style-type: none"> » Reduce conflicts between users and increase regulatory efficiency. » Facilitate the development of emerging industries such as wind and wave energy and aquaculture. » Help maintain ecological processes and the ecosystem services they support (such as fishing, marine tourism and recreation, and cultural uses of the ocean). 	<ul style="list-style-type: none"> » Charles Ehler » Fanny Douvère, UNESCO, Intergovernmental Oceanographic Commission and Man and the Biosphere Program

<p>Marxan with Zones www.uq.edu.au/marxan</p>	<ul style="list-style-type: none"> » Allows users to allocate land and/or sea parcels to multiple zones each with their own targets, planning unit costs, and biodiversity benefits » Allows users to create zoning plans that meet a variety of conservation and human-use objectives while minimizing the total cost of implementation » Examines problems related to biosphere reserves, multiple-use marine parks, off-reserve marine planning, and multiple-use terrestrial forestry planning. 	<p>» NOAA</p>
<p>Ocean and Coastal U.S. Legislative Atlas http://csc-s-maps-q.csc.noaa.gov/legislativeatl/index.html</p>	<ul style="list-style-type: none"> » Allows users to search an online spatial database of coastal and ocean legislation, according to geographic area, issue of interest, or management agency » Helps coastal- and ocean-resource managers make sense of the complex jurisdictional and regulatory system and identify potential gaps in the current management framework 	<p>» NOAA</p>