

Ecosystem Services Research Program Status Report and Future Directions, June 24, 2009

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1.1 Program Goal

The goal of the Ecosystem Services Research Program (ESRP) is to transform the way decision-makers understand and respond to environmental issues by making clear the ways in which their policy and management choices affect the type, quality and magnitude of the goods and services ecosystems provide to sustain human well-being.

The intent is to inform a wide range of issues related to questions of social choice, with a special focus on informing trade-offs among ecosystem services provided under alternative management and policy decisions. To achieve this objective, the ESRP has initiated a multi-dimensional research plan that includes a range of focused investigations with a number of cross-cutting, integrated, thematic elements. The focused investigations look at the provision of ecosystem services from three different perspectives:

- (1) The effect of a single, ubiquitous pollutant (reactive nitrogen) on ecosystem service quality and quantity;
- (2) The dynamics of service flows in two priority ecosystems (wetlands and coral reefs); and
- (3) The dynamics of ecosystem service flows in five geographic regions (Midwestern US; Willamette Basin, Oregon; Tampa Bay, Florida; Southwestern US ;and the Coastal Carolinas), that represent a spectrum of ecological and socioeconomic characteristics.

The cross-cutting themes include the relationship between ecosystem services and human health; landscape characterization; ecosystem service inventories; alternative management option modeling techniques; and ecosystem service valuation. There are plans to integrate the research outputs from the focused investigations and the thematic work into a decision support platform and to convey the findings through an organized education and outreach effort.

1.2 Conceptual Model and Description

The conceptual model for the Ecosystem Services Research Program (Fig. 1) represents the environmental dynamics of ecosystems, as well as the information flow that would be needed to support decision making. The model explicitly shows the feedback loop among the model components, including direct and indirect drivers of change, resulting stressors to ecosystems, effects on ecosystem services, and effects on human well-being. Indirect drivers include economics, demographics, and sociopolitical decisions that affect direct drivers (e.g., resource consumption, climate change, land use change). Direct

drivers regulate stressors that affect ecosystems at multiple spatial and temporal scales; these effects can vary greatly across ecosystems and locations.

The ESRP examines ecosystem services at multiple scales and configurations, including: 1) regional/national, scales especially amenable to analysis using principles of landscape ecology; 2) landscape scale, especially amenable for management decisions; and 3) an ecosystem scale, that enables examination of ecological patterns and functions as determined by the configuration and distribution of specific ecosystem types (e.g., wetlands). Changes in ecosystem attributes affect the delivery of services over space and over time, in turn, affecting components of human well-being. A feedback loop between human well-being and indirect drivers represents the effect that human well-being can have on socioeconomic decisions and policies.

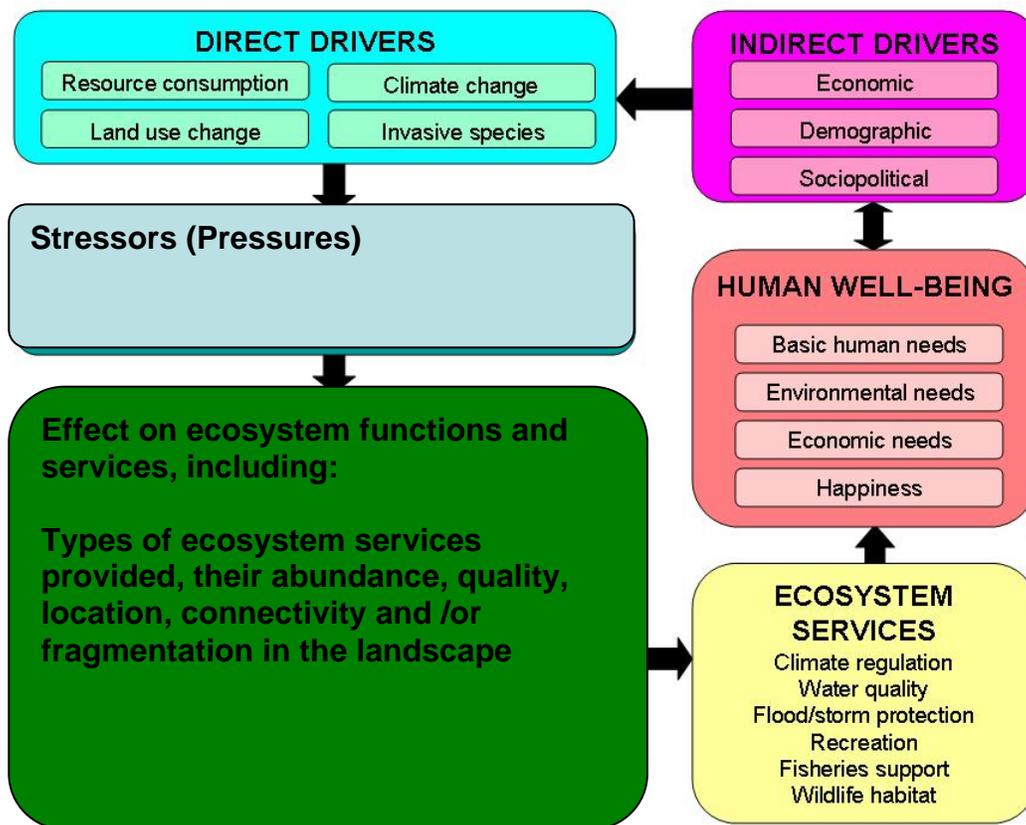


Figure 1: Conceptual Model of Services Model

1.3 Expected Impact/Rationale

EPA’s mission has always been to “protect human health and safeguard the natural environment upon which life depends.” This foreshadowed today’s interest in the interdisciplinary science of ecosystem services. EPA already protects some ecosystem benefits and services solely through regulation (the traditional approach). However, even this approach often begs the question of how best to achieve the mandated requirements. For example, how can a watershed be optimally managed to protect water quality, cost effectively, within an ever growing community? Current regulation of nutrients, for

example, has been hampered by insufficient authority to manage in total the effects of nitrogen on our land and water. Further, despite 39 years of progress, EPA faces ever more complex challenges. Numerous issues and interest groups vie for attention while budgets for environmental protection continue to fall in the depressed U.S. economy.

Imagine if we could engage industry, municipalities, investors, and insurance markets to work proactively to regain the benefits of nature, making the cost of regulation a secondary issue. Imagine the outcome if all these players routinely came together to invest, insure, and trade in the benefits nature provides. Imagine if doing so would enable society to conserve and even enhance these natural assets for the public good and future generations, while meeting or exceeding EPA's regulatory standards. Finally, imagine if this new coalition of public and private sectors created new jobs, reduced costs for municipalities and industry, and produced net benefits for people and our economy.

We anticipate such benefits are possible, as evidenced by initiatives underway in several municipalities and states. Ecosystem services are the evolving currency of environmental protection; regulatory and technological solutions alone cannot suffice for complex problems. We currently have no systematic research with which to design EPA policies and incentives to promote needed ecosystem investments and set priorities for implementation. In part, this is a legacy of piecemeal U.S. environmental law, which – although visionary in its conception and early implementation – is now yielding diminishing returns with respect to desired environmental outcomes. The ESRP intends to provide the transdisciplinary science that can enable transition from *ad hoc* successes to more systematic examination of such opportunities by EPA and its clients.

The ESRP offers a way to take the next step toward achieving incremental gains of environmental benefits by applying ecological science to conserve and enhance the natural benefits of ecosystems (e.g., by understanding landscape patterns and processes, cross-scale dynamics, threshold issues), perhaps even *without* having to impose regulations. ESRP's approach builds upon the Agency's historic emphasis on minimizing the impacts of pollutants (i.e., negative externalities) to create new ways to enhance the services we receive from functioning ecosystems, in ways that create new economic wealth and better addresses social equity (i.e., positive externalities).

Not only is this approach more balanced, it could also “create demand” for ecological integrity by rewarding stewardship and by connecting with the public on issues of social well-being and equity. ESRP's approach can provide a way to quantify the effects of real or potential losses created by our current piecemeal management of ecosystems. Moreover, ESRP's systems approach can provide information that integrates ecological and human dimensions required for effective proactive decisions. This systems approach to examining effects of stressors on sustained delivery of ecosystem services is the essence and unique quality of ESRP.

More specifically, we anticipate that the Program's research results, developed and communicated through collaborative research, can:

- 1) *Achieve increased efficiencies in public and private sector investments in ecosystem services*, by lowering transaction costs through research that can yield:
 - a) Standardized accounting methods for ecosystem services, f) Model “templates” for state statutes and local ordinances related to protecting ecosystem services, d) Model “templates” for contractual language for transactions that affect ecosystem services, d) Standardized spatial representations of sources and users of ecosystem services, and e) A systems-based approach to ecological risk assessment.

- 2) *Make explicit the business case for investing in ecosystem services through research results that act as a catalyst for:*
 - a) New opportunities to apply and evaluate tools for conserving ecosystem services throughout business operations, management, and product development, b) Strategic assessment of financial risks to businesses associated with lost ecosystem services, c) Strategic business placement via achieving environmental performance that goes beyond regulatory compliance, thereby ensuring and expanding business’s social license to operate, d) Increased ability to participate in new markets for exchanging, restoring, and enhancing ecosystem services in particular geographic areas. e) Identifying solutions that mutually benefit the regulated community and society via expanded voluntary measures, f) Disseminating information to the public in order to advance the science and raise the playing field for all business enterprises.

- 3) *Create expanded opportunities for place-based demonstration projects*, achieved through studying unique combinations of high-priority stressors acting within different communities and geographic areas (See also enclosed ESRP Summary document, section *LTG 5: Place-based studies*).

We present further details of this approach in Appendix F: Expanding Environmental Protection: Supplying ecosystem service science in support of ecologic and economic sustainability – Proposal for Funding.

1.4 Current Status

The ESRP has made significant progress in the past two years. Ongoing work initiated in the previous Ecological Research Program, from which the ESRP has grown, is now nearly complete, allowing the Program to focus almost exclusively on ecosystem services. The concepts presented in the 2008 draft Ecological Research Program Multi-Year Plan have now been converted into Research Implementation Plans. These individual Plans describe in detail the conceptual models that guide the research, the planned implementation sequence, and the status of activities. Summaries of these plans for individual ESRP components are provided in the enclosed document. *Summary and Status of ESRP Themes and Projects*. As recommended by the SAB EPEC, each of these plans have been, or will be, peer reviewed.

Plans have been reviewed and completed for several of the ESRP components: including the Future Midwestern Landscape (FML), and Tampa Bay Place-based studies; the Decision Support theme; Wetland Ecosystem theme; and the Nitrogen theme. The ecosystem service Mapping component of the program and the Coral Reef Ecosystem

have made important advancements; each will complete their implementation Plans this year. The Monitoring and Modeling themes, and the Southwestern U.S. Place-based study (a new addition to ESRP's Place-based studies, as recommended by the SAB EPEC) will have Implementation Plans for review next year.

The reactive Nitrogen research theme has completed its peer reviewed Implementation Plan. As is well known in the scientific community, nitrogen inputs to the environment have increased significantly in the past few years. Nutrient management, in general, is one of the highest priority issues for the Office of Water, and a secondary standard for atmospheric nitrogen is being reviewed by the Office of Air and Radiation. Nitrogen issues are evident in all the current place-based studies, wetlands, and coral reefs. Nitrogen management issues require tangible research methods and products to be developed from ESRP's modeling, monitoring, mapping and decision support themes. Thus, nitrogen research is a natural hub involving all aspects of the ESRP.

In 2009, the ESRP was able to increase its resources for nitrogen research by about \$2 M, which will fund a pilot study on reactive nitrogen. This pilot study is intended not only to advance the quantitative relationship between services and nitrogen, but also to advance ESRP's program-wide integration, as recommended by the SAB EPEC. The pilot shows potential to make important progress on ecosystem service issues of high priority to the Agency, especially those related to ambient air standards for NO_x; more spatially explicit accounting of nitrogen sources and sinks; improved understanding of greenhouse gas emissions; and clarify ecosystem service tradeoffs related to water quality trading, especially within wetlands systems.

This pilot will use ESRP's disciplinary strengths to make advances at the intersections of its thematically organized research on (1) reactive nitrogen, (2) wetlands, (3) national mapping of ecosystem services, (4) modeling, especially synthesizing the results of existing nitrogen modeling studies in order set priorities for work needed to reduce remaining uncertainties, and (5) client-based scenario development to proactively explore alternative management options. Integrative and innovative research at the nexus of these research themes will be designed and implemented in collaboration with EPA clients, stakeholders, and partners at ESRP place-based demonstration sites (For more information, see also the Nitrogen summary in the enclosed document, and Appendix A: of this document: *ESRP Coordination and Integration*).

To date, the Program has not been able to gain sufficient resources to achieve its originally intended goals for Outreach and Education, and Valuation and Human well-being. Implementation plans are not being prepared for these areas, however, exploratory research is underway for each. These topics remain an important ESRP component, yet it remains a challenge to initiate them at the needed level of effort.

1.4.1 Current Impacts, Critical Accomplishments and Innovations

See enclosed document: *Summary and Status of ESRP Themes and Projects*.

1.4.2 Publications and Papers Presented in FY 08/09 and forthcoming

See section on Publications and Papers for each individual theme and project summary, in enclosed document, *Summary and Status of ESRP Themes and Projects*.

1.4.3 Resources

The ESRP is almost exclusively an in-house research program. The total budget for the ESRP is approximately \$70M dollars annually, down from over \$100 M dollars in 2004 (but up slightly in FY 2009). The Program has approximately 280 FTE, of which about one third are managerial and support staff.

There is essentially no money for grants and few contract support dollars. We have acquired funds for expert hires to complement the expertise of our in-house staff. These experts are considered Special Government Employees (similar as for SAB members), allowing them to advise and interact with ESRP science Leads. A list of these experts and their contributions to the Program is provided in *Appendix D: Expert Hires to Complement In-House Expertise*.

1.5 Response to Comments

At the programmatic level, we have focused on EPEC's comments relevant to multiple theme and project areas. Our summary responses to these issues are provided in the following:

- As requested, we more fully explain how we have designed ESRP to achieve inter-program and intra-program coordination (See *Appendix A: Program Coordination and Integration*)
- As requested, we explicitly link the recommendations from the 2007 SAB, *Advice to EPA on Advancing the Science and Application of Ecological Risk Assessment to in Environmental Decision-making*, to planned and ongoing activities to ESRP research themes and project (See *Appendix B: Contribution of ESRP to Ecological Risk Assessment*)
- As suggested, we have begun reviewing the findings from the May 2009 SAB Report *Valuing the Protection of Ecological Systems and Services (CVPESS)*. We provide a *preliminary* summary of these findings and their relationship to ESRP (See *Appendix C: Valuation & Human Well-being and relation to SAB CVPESS Report*)
- We have hired additional expertise as recommended, especially from the fields of economics, decision science, policy, and modeling (See *Appendix D: Expert hires to complement in-house expertise*)

- We have announced a public-private National Ecosystem Services Research Partnership, and have received more than 160 expressions of interest from state legislatures, state resource agencies, regional planning councils, interdisciplinary research institutions, professional ecological organizations, NGOs, businesses, federal agencies, and legal practitioners. We are moving forward to facilitate initiation of this partnership (See *Appendix E: Public-Private Partnership for National Ecosystem Services Research*)
- We have developed proposals to the Agency describing novel uses of ESRP for environmental management and for guiding public and private investments (See *Appendix F: Expanding Environmental Protection: Supplying Ecosystems Service Science in support of Ecologic and Economic Sustainability – Proposal for Funding*)
- We have successfully developed closer ties to the Air and Water Offices in EPA; the Office of Air and Radiation will be adding a part-time person to work directly with ESRP. A draft example of an approach to better ensure such collaborations can be seen in *Appendix G: ESRP and the Office of Air Quality, Planning and Standards: draft and evolving commitment for collaboration.*
- We have summarized recent accomplishments made by ESRP, shown in *Appendix H: Selected ESRP Accomplishments, 2007 – 2009.*

In addition, we highlight the following actions in response to EPEC comments:

- Partnerships have been a high priority and have been expanded significantly.
- The Outreach and Education, and Decision Support themes have engaged users in developing their implementation plans and in tool development.
- Federal agencies joined together to sponsor and participate in a major conference on ecosystem services, as evidenced in its 200 papers, presented to 350 attendees, representing 12 countries and 6 continents. ESRP actively participated in this conference, from its inception to its execution; work now underway for second meeting in 2010.
- Twelve Research Implementation Plans have been developed for individual ERSP themes and project. As requested by EPEC, these Plans provide details about the design, integration, and implementation of the ESRP strategy. Many of these Plans are now in peer review, others are still in development. Status and highlights of these Plans are provided in separate enclosed document.
- Place-based studies have added a study in the arid Southwest, as suggested.

- As requested, we are now addressing transboundary issues in two Place-Based studies: the Future Midwestern Landscapes (FML) and the Southwest Ecosystem Services Project (SWESP).

1.6 Challenges

The ESRP faces challenges, many of which we believe slow, *but do not negate*, the Program's continued future progress.

-The science of ecosystem services is emerging, dynamic, and non-trivial to implement. Program staff are still learning the full dimensions of ecosystem services science, including how services relate to human health and well-being; how metrics for services contrast with more conventional measures of ecological condition; and how to create meaningful ecological production functions, given the multiple spatial and directional attributes of ecosystem service production and delivery.

-Resource constraints are, in general, a constraining factor in most of the research underway, including:

- Expertise is limited in the social sciences, including economics. Current resources are not sufficient to correct this deficiency.

- It has been difficult to keep the Education and Outreach theme operating at the required level of interaction.

- The relationship between ecosystem services and human health and well-being is an area of exciting new science with important implications for the Agency, but with few FTE.

- Current travel budgets severely restrict field collections, as well as impeding staff level coordination within ESRP, with EPA clients, and with external partners.

- Useful and appropriate metrics for measuring the Program's success have not been identified.

- It is difficult to get sufficient input from Program Offices, due to their already busy schedules and need to focus on pressing day-to-day program issues.

- Similarly, it is difficult for multiple agencies to truly collaborate, due to time and resource constraints, and need to focus on their primary mission.

- The Agency is still very much focused on the critical statutes required today and not on future alternatives. Further, human health and chemicals are still the predominant driver for most funding.

Appendices

Appendix A: ESRP Coordination, Integration, and Partnerships

Appendix B: Contribution of ESRP to Ecological Risk Assessment

**Appendix C: ESRP Valuation & Human Well-being themes and Relation to SAB
CVPESS Report – Preliminary observations**

Appendix D: Expert Hires to Complement In-house Expertise

Appendix E: Public-Private Partnership for National Ecosystem Services Research

**Appendix F: Expanding Environmental Protection: Supplying Ecosystem Science
in Support of Ecologic and Economic Sustainability**

**Appendix G: ESRP and the Office of Air Quality, Planning and Standards: draft
and evolving commitment for collaboration**

Appendix H: Selected ESRP Accomplishments 2007 – 2009

Appendix A: ESRP Coordination, Integration, and Partnerships

In its September 30, 2008 Advisory to EPA, the EPEC made several recommendations that apply to multiple aspects of ESRP's organizational structure, its goals, and its approach to implementation. We respond below to three inter-related recommendations regarding ESRP's approach to integration and coordination, remaining nimble in a dynamic research environment, and leveraging resources through partnerships.

1) *Integration and coordination:* *“The Plan should provide greater detail on how EPA will accomplish intra- and inter-program coordination and inter-institutional collaboration on the proposed research.”*

The ESRP was designed from the outset as a fully integrated research program across all ORD Laboratories and Centers. This is a distinct change from the organization of the Program in the previous Multi-Year Plan, where the four Long-term goals were presented, in large part, as separate activities, championed and executed primarily by one Lab or Center (e.g., most restoration work was done by NRMRL, most EMAP condition monitoring by NHEERL). This new approach to integration is reflected in the ESRP organizational matrix (Figure 1) which shows ESRP's five Long-Term Goals (LTGs) as well as their subcomponents.

LTG 1: Integration, decision support and outreach: keeping the end in mind

LTG 2: Monitor, map, and model ecosystem services at multiple scales

LTG 3: Pollutant specific studies: reactive Nitrogen

LTG 4: Ecosystem specific studies: wetlands and coral reefs

LTG 5: Community based demonstration projects for regional, state, and local decisions

Research on these goals is conducted in an integrated fashion, by way of teams led by a senior ESRP scientist who provides intellectual leadership to a team of staff drawn representing all of ESRP's theme and project areas. This approach ensures cross-fertilization and coordination internally within ESRP. In addition, teams are drawn from all ORD's Labs and Centers; this enables coordination and cross-fertilization within ORD. As a result, the ESRP has successfully prepared MYP *Program-level* Research Implementation Plans.ESRP; a first within ORD. The ESRP has twelve Implementation Plans scheduled for completion in FY 2009; three others are proposed for late FY 2010. All will be peer reviewed by internal and external scientists; several Plans are already in review.

In addition to ESRP science staff, the ESRP matrix includes participation by EPA Regional staff and EPA Program Office staff. We intend to increase participation by EPA clients in the future through our continuing outreach and communication efforts, a sub-component of LTG 1.

2) *Remaining nimble in a dynamic research environment:* *“The Plan would do well to recognize that the environment, institutions, and human welfare are changing at an unprecedented rate, and as new situations, new priorities, and new ideas develop, EPA*

should remain nimble enough to identify new “services,” ask new questions, and apply new measurement techniques.”

We agree this is a critical time in the development of ecosystem service science. The field is highly dynamic, with many new participants, new ideas, and requests to respond to new and different environmental management issues as they relate to ecosystem services. At this juncture, it is important to develop credible science based on a cohesive approach, even during this time of innovation and testing.

This need influenced the design of ESRP, which intends to promote research that can yield credible scientific findings in the shortest possible time. To that end, the ESRP includes concepts drawn from “experimental design.” Just as statistical experimental design is used to efficiently test hypotheses regarding the influence of interactions on experimental results, so too is the ESRP designed to be implemented by way of deliberately selected “interactions” of foundational ecological research with *exploratory research* in valuation, decision support, and outreach, and with replicated by *place-based demonstrations*.

Foundational research is conducted within LTG 2 (Mapping, Monitoring, Modeling) and LTG 4 (Wetlands and Corals Themes) and builds directly upon ESRP’s expertise in these topics. *Exploratory research* is conducted within LTG 1, reflecting ESRP’s commitment to develop new research capabilities in the social, economic, and decision sciences essential to truly transdisciplinary research. ESRP intends to build greater capabilities within LTG 1 over time, both via enhanced in-house staffing and by creating new partnerships with Regions, EPA Programs, and external partners, though, to date, doing so has been challenging.

The ESRP also conducts *place-based research* in collaboration with stakeholders and regional decision-makers, enabling them to examine scenarios to proactively conserve and enhance ecosystem services; i.e. these demonstrations are focused on actual environmental outcomes. ESRP study locations represent a spectrum of physiographic and socioeconomic characteristics in order to provide “replication” and consistency to enable methodological comparisons, as well flexibility for innovation and testing. These demonstrations allow us to learn more quickly and achieve results faster. These place-based “replicates” include scenario development and other decision analytic tools carried out with clients.

In sum, the ESRP does not follow a conventional linear path from design, to publication, to ultimate dissemination of results to clients many years hence. Instead, the Program embodies a transdisciplinary approach to research. It is designed as a matrix of interactions: i.e., [foundational research] x [exploratory research] x [replicated demonstrations, at different spatial extent and resolution]. ESRP’s goal across all these areas is to develop analytical methods that are standardized sufficiently to enable comparative testing and rigorous evaluation, while flexible enough to allow for innovation and refinement. We are developing a formalized “cross-place-based” research theme to enable such testing. We intend to improve our ability to implement testing and

refinement via early and continuous input from the scientific community, stakeholders, and clients, so that we can promote scientific advances at the “intersections of the “x’s.”

3) Recommendation: Leveraging through partnerships: “Recommends effectively partnering with other federal agencies, NGOs, professional societies, private businesses, and foundations to leverage available resources.”

In 2008, ESRP initiated three new arenas for partnerships: 1) collaborations with Business for Social Responsibility, 2) proposed participation in the follow-up to the Millennium Assessment, and 3) a proposal for creation of a public-private partnership for national research on ecosystem services. We intend to be fully engaged in these new areas by 2011. Highlights for each follows:

1. Business for Social Responsibility (BSR): April 2008. Discussion focused on understanding the variety of ES tools under development and how they might be used in decisions by business. ESRP was first federal program to be invited to participate in BSR discussions. ESRP is now partnering with BSR, the University of Vermont’s (UVM) EcoInformatics Collaboratory, and UVM’s Rubenstein School of Government, for a more in-depth workshop on tool development and use by businesses, in October, 2009. This follow-up meeting will include representation by additional tool developers from non-governmental organizations, as well as representation by other federal agencies, (e.g., USDA Office of Ecosystem Services and Markets, USGS, U.S. Forest Service).

2. Millennium Assessment “II”: Sub-global assessments of ecosystem services. The 2005 release of the Millennium Assessment brought the issue of declining ecosystem services to the worldwide attention of governments, researchers, and conservation organizations. Work is now underway in many countries to conduct ecosystem service assessments at finer spatial resolution (aka “sub-global assessments.”). The ESRP announced in December 2008, its intention to use its five place-based studies as part of the U.S. contribution to this effort. The initial response from the Smithsonian, NGOs, and academic institutions that are proposing to participate in this MA follow-up has been very positive. We are in the early stages of discussing partnerships and analytical methodology for conducting these assessments. As with the 2005 Millennium Assessment, this work is fully integrated and transdisciplinary, melding natural, social and decision sciences.

3. Public-private National Ecosystem Services Research Partnership (NESRP). ESRP has announced its intention to facilitate creation of a public-private partnership for ecosystem services research. This partnership represents an unprecedented opportunity to leverage public and private resources to enhance conservation of ecosystem services. We have received more than 160 expressions of interest from state legislatures, state resource agencies, regional planning councils, interdisciplinary research institutions, professional ecological organizations, NGOs, businesses, federal agencies, and legal practitioners. We are moving forward to facilitate initiation of this partnership. Details of this Partnership opportunity are provided in *Appendix E: Public-Private Partnership for National Ecosystem Services Research*.

ESRP Organizational Matrix

Projects and Long term Goals →		Eco-system Specific Studies: LTG 4--23%		Community Based Demonstration Projects: For National, Regional, State and Local Decisions (includes Nitrogen and Wetlands services) LTG 5—28%				Theme Leads
	Cross Program Themes and Research Objectives	Wetlands (19%)	Coral Reefs (4%)	Willamette (5%)	Tampa Bay (7%)	Mid-West (7%)	Coastal Carolinas (9%)	
Inventory, Map, and Forecast Ecosystem Services at multiple scales (National Atlas) LTG 2 38%	Landscape Characterization and Mapping (10%)	Ric Lopez	Anne Neale	Don Ebert	Taylor Jarnagin	Megan Mehaffey (New Hire in the future)	Deb Chaloud	Anne Neale
	Inventory and Monitoring of Services (21%)	Jack Kelley	Bill Fisher	Spence Peterson	John Macauley	Joe Flotemersch	Darryl Keith	Mike McDonald
	Modeling for Scenarios and Forecasting for different management options (7%)	Brenda Rashleigh	Susan Yee	Bob McKane	Sandy Rimondo	Russ Kreis	Steve Kraemerr	Tom Fontaine
Integration, Decision Support and Outreach LTG 1 8%	Ecosystem Services and Human Health (2%)	Kevin Summers	Kevin Summers	Steve Klein	Lisa Smith	Betsy Smith	Deb Mangis sending name	Laura Jackson
	Valuation of Ecosystem Services (2%)	Chuck Lane	Dan Campbell & Suzanne Ayvazian	Matt Weber	Sharon Hayes	Alex Macpherson	Alex Macpherson	Wayne Munns (temp.)
	Decision Support Platform Created to Integrate Findings from Entire Program (3%)	Tim Canfield	Pat Bradley	Dave Burden	Marc Russell	Vasu Kilaru	Drew Pilant	Ann Vega
	Outreach & Education to (1%)	Janet Nestlerode	Pat Bradley	Bill Hogsett	Jim Harvey	Brenda Groskinsky	Walt Galloway	S. Marcy (extended leave)
Eco-system Specific Studies LTG 4	Wetlands (23%)				Janet Nestlerode	Chuck Lane		Steve Jordan
Pollutant Specific Studies LTG 3	Nitrogen (5%)	Steve Jordan	Jim Latimer	Bill Hogsett	Richard Devereaux	Ken Fritz	Brent Johnson	Jana Compton
Project Area Leads	Rick Linthurst And Iris Goodman	Janet Keough	Bill Fisher	David Hammer	Marc Russell	Randy Bruins/ Betsy Smith	Deborah Mangisorthy	Rick Linthurst Iris Goodman
				Megan Mehaffey Place Based Coordinator				

Appendix B: Contribution of ESRP to Ecological Risk Assessment

We agree with EPEC's finding that there are many connections between the ESRP and EPA's extensive experience with ecological risk assessment. For context, we quote below three findings from EPEC:

The Committee finds that ecosystem services assessment is an activity that will provide decision makers with information to translate ecological risk assessments into management strategies for achieving sustainable future environmental protection (p. 6).

The Plan should describe the linkages between EPA's previous ecological risk assessment research and the proposed new direction of quantifying ecosystem services and their contribution to health and well-being (p. ii).

*The vision outlined by EPA [ESRP] is a plan to develop the next generation of environmental management support technologies that build on risk assessment. **The Committee finds that the resulting knowledge and tools will more completely support effective evaluation of management alternatives and improved communication of benefits to the public than is presently the case (p. 3, emphasis added).***

This Appendix responds to EPEC's request to explicitly describe the relationship and contribution of ESRP to ecological risk assessment, especially as relates to the findings of the US EPA SAB 2007 report, *Advice to EPA on Advancing the Science and Application of Ecological Risk Assessment in Environmental Decision-making*. We have reviewed this report (hereafter referred to as "*Advice to EPA*" SAB, 2007), and identified 13 of its recommendations that closely align with ESRP activities.

We summarize below, in a preliminary way, those planned and ongoing activities within ESRP that substantially respond to the 2007 SAB report. These 2007 recommendations (slightly paraphrased for brevity) are enumerated in the list below, followed by highlights of ESRP activities that respond to each. These ESRP activities are categorized by ESRP Long-Term Goals, beneath each recommendation.

Further, we agree with EPEC that ESRP is creating the next generation of environmental management support technologies that build on risk assessment. As noted in *Advice to EPA*, there are many aspects of ESRP's design that enable the Program to make unique contributions to a new and improved approach to ecological risk assessment. These include ESRP's:

- 1) transdisciplinary design, which mitigates against "fragmentary risk analyses";
- 2) strength in quantitative landscape ecology, and hence, analyses that cross multiple space- and time-scales;
- 3) emphasis on systematic examination of effects of non-chemical stressors on ecosystems and their services, so that both chemical and non-chemical stressors can be better evaluated together.

- 4) ecosystem service assessments that lend themselves to meta-analyses, such as in ESRP's Place-Based studies and Wetlands studies;
- 5) studies that include Bayesian analyses and "weight of evidence," as preliminarily begun in Decision Support and in Modeling themes; and
- 6) pioneering efforts to identify how social attributes of ecosystem services translate to assessment endpoints that meet decision maker needs, as being investigated in ESRP's Monitoring and in Place-Based studies.

Status of ESRP Research Activities with Respect to SAB 2007 Ecological Risk Assessment Recommendations

Recommendation 1. Better define ecological attributes to be protected in EPA decision (short-term action note: these time frames refer to SAB 2007 recommendations for action):**

LTG 1 – Valuation and human well-being: Type and location of urban-associated forest cover provides quantifiable benefits to air and water quality, stormwater retention, and temperature modulation.

LTG 2 – Monitoring: Ecosystem Services Endpoints Workshop: will bring together economists and ecologists to define ES endpoints that are both socially relevant measureable, July 2009.

LTG 4 – Wetlands: Wetland theme is narrowing the list of ecosystem services relevant to EPA programs.

LTG 5 – Place-based studies. FML: Changes in carbon sequestration under different policy options informs GHG rule. Spatially-explicit assessment results will support NDPEs permitting by allowing assessment of cumulative effects, including broad and fine scale. Improvement in CMAQ ability to assess ammonia flux related to fertilization will inform regulatory decisions on PM.

Recommendation 2. Maintain focus on research to develop methods for valuation of ecosystem services (long-term action):

LTG 1 – Valuation and human well-being: Research on multiple human health and well-being endpoints supplements economic valuation with additional societal issues of high value.

LTG 5 – Place-based studies. FML: Decision science (Analytical Hierarchical Procedure / values elicitation for "maximum services" scenario development); we are exploring ecosystem benefit indicators (e.g., scarcity/capacity indicators, benefit response

curves, acceptable risk), beginning on biophysical rankings (similar to FSA's Environmental Benefits Index). Initially starting with habitat and areas with potential for linking patches – then moving to where BMPs will be most effective, etc.

Recommendation 3. Advance development of tools to assess net environmental benefits (long-term):

LTG 1 – DSF: The DSF team is compiling existing tools so identify gaps; we are also interacting with stakeholders and decision-makers to determine their decision needs.

LTG 5 – Place-based studies. FML: Continued development of Environmental Decision Toolkit (EDT) – advanced synthesis methods, drilldown capability, and linkages with other applications.

Recommendation 4. Provide interface with monitoring programs so new data can improve assessments (long-term):

LTG 2 – Monitoring: Working with Office of Water on National Assessment of Rivers and Streams – lakes, streams and rivers, wetlands, estuaries.

LTG 2 – Monitoring: National Coastal Assessment (EMAP) design and data being used for geospatial analysis of habitat values – also, National Wetlands Assessment will be a major resource for the ESRP Wetlands project.

LTG 2 – Monitoring: ESRP convened panel at US Society for Ecological Economics annual meeting (June 2009) to discuss potential for national monitoring of ecosystem services to contribute to new national income accounts (e.g., “green” GDP and other indicators of well being)

LTG 4 – Wetlands: LTG4 Wetland theme is involved in planning the EPA National Wetland Condition Assessment to incorporate indicators useful to estimating ecosystem services.

LTG 5 – Place-based studies. FML: Coordination with Iowa Soybean Assoc. in monitoring effects of management; possible RARE grant with Region 5 to monitor changes in water quality in upper Mississippi.

LTG 5 – Coastal Carolinas: Evaluating how technologies such as remote sensing can be used to monitor coastal ecosystem services.

Recommendation 5. Endpoints should reflect landscape pattern and composition and include effects of non-chemical stressors (short-term):

LTG 1 – Valuation and human well-being: Habitat configuration as an indicator of native biodiversity is being correlated with rates of Lyme disease and West Nile virus.

LTG 2 – Monitoring: examining nutrients, sediments, and habitat stressors effects on ecosystem services, building towards using watersheds for spatial accounting.

LTG 2 – Monitoring: examining habitat change and values in a landscape context.

LTG 5 – Place-based studies. FML: Assessment of habitat changes at multiple scales – resulting in improvement in FSA’s calculation of environmental benefits for wildlife; opportunities for improving stopovers for migratory birds (FWS).

Recommendation 6. Promote statistical and geospatial data analysis tools for identifying appropriate spatial and temporal scales and their interrelationships (long-term):

LTG 1 – DSF: The DSF team is compiling existing tools so identify gaps; we are also interacting with stakeholders and decision-makers to determine their decision needs.

LTG 2 – Monitoring: Developing statistically sound monitoring framework for use in inventory and monitoring of ecosystem services at regional and national scales.

LTG 5 – Place-based studies. FML: Environmental Decision Toolkit is combining the best from SPlus and ArcServe , to create improved tool.

Recommendation 7. Explore ways, including Bayesian analysis, to focus hypothesis development on causal relationships and weight of evidence instead of traditional null models (long-term):

LTG 2 – Monitoring: Examining conditional probability as a means of establishing thresholds for ecosystem service restoration.

LTG 2 – Modeling: Proposing Bayesian analyses as key component to new model development

LTG 3 – Reactive nitrogen: Proposing synthesis of existing results from nitrogen models as method to assess weight of evidence and to set priorities for hypothesis testing to reduce greatest remaining uncertainty.

LTG 5 – Place-based studies. FML: Scoping exercise to assess inclusion of Bayesian approaches in study area.

Recommendation 8. Develop guidance for improved weight of evidence covering major ecoregions, hydrologic types, and both chemical and non-chemical stressors (long-term):

LTG 2 – Monitoring: Working with Office of Water National Assessment of Rivers and Streams to add ecosystem service indicators to assessments.

LTG 4 – Wetlands: research is oriented around major classes of wetlands (FWS Status and Trends wetland types) to provide informative classifications; many non-chemical stressor effects on wetland are included

Recommendation 9. Identify spatial and temporal scales large enough to capture emerging patterns (short-term):

LTG 1 – Valuation and human well-being: Road-bounded landscapes, including Census tracts, have been found to be the best units to explain large-scale spatial variability in Lyme disease rates.

LTG 2 – Monitoring: ESRP presented paper addressing the appropriate scales for quantifying and valuing ecosystem services at US Society for Ecological Economics annual meeting (June 2009) The topic of our USSEE paper is the

LTG 3 – Reactive nitrogen: Data sets on nitrogen sources and nitrogen removal as an ecosystem services are being generated at multiple scales (national, regional and local) in order to test and determine the appropriate scale for detecting patterns and making decisions.

LTG 4 – Wetlands: Wetland studies are developing regional approaches to describe and estimate ecosystem services provided by wetlands.

LTG 5 – Place-based studies. FML: This study is examining the effects of biofuels production over 12 midwestern states, and 20 year time horizon.

Recommendation 10. Consider ongoing change processes (e.g. climate change) and effects on other anthropogenic stressors and indirect effects on natural resources (short-term):

LTG 4 – Reactive nitrogen: We are adding new climate change research to the Nitrogen Implementation Plan; several reviewers emphasized the importance of this interaction. We are working with internal partners to examine nitrogen impacts on ecosystem carbon storage, and climate change impacts on water quality via changes in nitrogen removal and losses from watersheds.

LTG 3 – Wetlands: Wetland research in the Northeast is addressing sea level rise functions of wetlands, along with other ecosystem services

LTG 5 – Place-based studies. FML: Examining multiple change processes, including land use and population change, increase in biofuels industry, changes in transportation (from MARKAL), changes in agricultural chemical inputs – e.g., increased NPS pollution, degraded air quality, etc.

LTG 5 – Place-based studies. Coastal Carolinas: Using two climate change scenarios; i.e., slow change and threshold (tipping point) change to examine their effects on development patterns, adaptation strategies, and their impacts on services.

Recommendation 11. Categorize uncertainties according to their sources and sizes (short-term):

LTG 2 – Monitoring: Uncertainties quantified in national surveys using probability design.

LTG 3 – Reactive nitrogen: accounting to estimate national nitrogen source and removal will include estimates of uncertainties.

LTG 4 – Wetlands: Wetland conceptual model of ecosystem services is examining the uncertainties associated with relationships among stressors / functions / condition and services

LTG 5 – Place-based studies. FML: FML scoping exercise – begin with conceptual model, extensive lit review, BPJ estimation of direction and magnitude of changes as well as amt of uncertainty and major gaps. Ongoing sensitivity analyses of models.

Recommendation 12. Explicitly identify ecological resources to be protected and options for their protection during problem formulation (short-term):

LTG 5 – Place-based studies. FML: Development of values hierarchy, which also illustrates trade-offs. Development of “maximum services” scenario incorporates best of conservation science.

LTG 5 – Place-based studies. Coastal Carolinas: Currently identifying all of the ecological resources to address, but will be evaluating coastal wetlands, and means to protect wetlands and their services under different climate and development scenarios – including purchasing land in areas that could become the marshes with sea level rise.

Recommendation 13. More fully describe beneficial ecological consequences from risk management decisions in lay terms (short-term):

LTG 5 – Place-based studies. FML: Values elicitation workshops provide context and illustrate trade-offs. Decision tool improves accessibility by clients. Outreach is conducted through partners, e.g. Regional Offices, Great Lakes National Program Office, FWS

LTG 5 – Place-based studies. Coastal Carolinas: Will use two climate scenarios – slow change, and tipping point change; and three Adaptation scenarios: Business as usual, climate-smart growth, and relocate/rebuild to examine effects on ecosystem services.

Appendix C: Valuation & Human Well-being and Relation to SAB CVPESS Report

As suggested, the staff Leads for ESRP's Valuation theme have begun reviewing the findings from the May 2009 SAB Report *Valuing the Protection of Ecological Systems and Services* (CVPESS). We summarize below a preliminary summary of the relationship of CVPESS findings to the ESRP.

The following themes in the CVPESS report appear especially relevant to ESRP:

- The central message is to embrace a broader view of value. Perhaps the strongest critique of traditional EPA practice, and a potential opportunity for what the ESRP could address, is found in the report as this statement:

"...the Agency's value assessments have often focused on those ecosystem services or components for which EPA has concluded that it could relatively easily measure economic benefits, rather than on those services or components that may ultimately be most important to society. Such a focus can diminish the relevance and impact of a value assessment." (Executive Summary, Page 2; idea is repeated in Chapter 2, page 21, as well as in the Conclusions, Page 100).

- CVPESS advocates developing a conceptual model early on to intentionally focus on ecosystem services that are the most important to society. This is important change from studying items of interest to individual researchers, or focusing on items for which data already exists.
- Implied by the need to focus on ecosystem services of most value, is increased engagement with stakeholders early and throughout the research process to achieve and maintain the focus on ecosystem services important to the public.
- Numerous valuation perspectives are listed in CVPESS, thus suggesting that the ESRP should incorporate social sciences drawn from disciplines that are much broader than just economic valuation perspectives.
- The CVPESS report and the SAB CVPESS technical briefing note that much of their work was in achieving consensus on broad valuation issues. Specific guidance for on-the-ground projects is not included and such guidance may not be possible through an SAB process. At this stage, progress can be made in this area through resources invested in specific projects to allow leading 'by example.'
XXX
- The CVPESS report filled an important role in explicitly defining terms and concepts. However, there remains a need to further refine these terms to ensure ESRP natural scientists and social scientists are communicating with the same vocabulary.

- There is good information in the report, and in other supplemental materials on the web; but there remains the need to translate and make these recommendations more immediately useful to ESRP scientists.
- There is an opportunity to coordinate ecosystem service valuation efforts across the ESRP in order to achieve understand and create methods for ecosystem services assessments. An ESRP-wide approach would encourage cross-fertilization and likely yield better results than doing so on the basis of stand-alone projects.

Appendix D: Expert Hires to Complement In-house Expertise

EXPERTISE AND CRITICAL CONTRIBUTIONS OF EXPERT HIRES TO ESRP		
EXPERT	RELEVANT EXPERTISE	IMMEDIATE CONTRIBUTIONS TO ESRP
<p>Dr. Daniel P. Ames Idaho State U.</p>	<p>Development of GIS-based tools</p> <p>Watershed modeling for environmental management</p> <p>MapWindow program, a flexible and influential tool for environmental assessment and management</p>	<p>Development of an implementation plan for geographic information and decision support systems</p> <p>Probabilistic modeling and decision analysis for integrated monitoring and modeling, including scenario development, inclusion of expert knowledge, and probabilistic risk and uncertainty analysis</p> <p>Application and comparison of implementations considered by the ERP Ecosystem (Wetlands, Coral Reefs), Place-Based, and other ERP Teams.</p>
<p>Dr. Allyson M. Beall, Washington State U.</p>	<p>Combining participatory facilitation with system dynamics modeling in a dynamic process</p> <p>Handling widely disparate types of data, stressors, values and concerns of communities</p>	<p>Interpreting and integrating information from internal and external technical groups into system dynamic models for displaying and evaluating inter-relationships and value changes for the multiple and disparate variables within a region consistent with the needs for evaluating ecosystems services</p> <p>Guiding scientific teams in refining models for projecting environmental health and social outcomes from alternative decision options for futures analyses</p> <p>Refining and revising models using new data from research teams and designing resource materials for presentation to clients in an iterative process for model refinement and outreach activities.</p>
<p>Dr. John P. Bolte, Oregon State U.</p>	<p>Alternative Futures Analysis for Land Use Planning and Sustainability</p> <p>Mathematical modeling and spatial simulation of environmental and agricultural systems</p> <p>Geographic Information Systems-based modeling</p> <p>Artificial intelligence applications in Bioresource management</p>	<p>Willamette Basin Alternative Futures and Land Use Change Trajectories of Change using Multiagent-based models of actors, policies and landscape production of ecological, social and economic goods and services</p> <p>A multi-disciplinary assessment of basin-scale ecological management, integrating agricultural impacts and issues, wildlife habitat management, riparian zone management, land use patterns, and socioeconomic evaluations with the goal of producing analysis tools for effective scientifically-based management</p> <p>Web-based decision support tools for</p>

		utilizing spatial datasets with distributed models of ecosystem processes, with applications in the Pacific Northwest and the Gulf of Mexico focused on coastal habitat
Dr. James W. Boyd, Resources for the Future	<p>Ecological benefit assessment</p> <p>Environmental performance metrics</p> <p>Law and economics</p> <p>Environmental policy</p> <p>Regulatory economics.</p>	<p>Assist the Monitoring Team in identification and development of ecosystem services endpoints that are a) appropriate for reporting on the current status and trends in ecosystem services at national and regional scales, including potential inclusion in national accounts and b) appropriate for planning and management groups to measure the effectiveness of management actions</p> <p>Assist in planning and conducting a national workshop to identify measures that can be used as the basis for reporting on ecosystems services quantity, quality, and value.</p>
Dr. John A. Harrison, Washington State U.	<p>Development and use of spatially explicit, global models of nutrient and organic matter</p> <p>Examination of nutrient and greenhouse gas dynamics at regional scales</p> <p>Use of experimental, remote sensing, and modeling approaches to elucidate processes governing the mobilization, transport, transformation and ecosystem/biochemical impacts of land-based N and P.</p>	<p>Plan and strategy for applying GLOBAL NEWS dissolved inorganic nitrogen and dissolved organic nitrogen models at the national and regional scales to estimate nitrogen sources due to various land use activities and removal by various landscape components</p> <p>Run Global NEWS DIN model at the national scale to yield spatially explicit information of N input sources and DIN export</p> <p>Expert advice to the ESRP-N Team</p> <p>Determine how the ERSP-N program can be improved and streamlined to aid in air quality and water quality decision making related to nutrients</p> <p>For a place-based study, lead the assessment of the utility and accuracy of N source information at national and local scales</p> <p>Develop a strategy and plan for modeling N removal by lakes, streams and reservoirs at national and local scales</p>
Dr. Marisa J. Mazzotta	<p>Environmental and natural resources economics</p> <p>Regulatory and policy analysis re: non-market</p>	Advice to ESRP Case Study leads in seeking ways their data can be used in non-market or market valuation and decision support

	<p>valuation of ecosystem services</p> <p>Valuation of ecosystem services</p>	<p>Assist in bridging traditional Clean Water Action or other EPA types of indicators and assessments to ecosystem services valuation</p> <p>Assist Wetland teams determine what values, metrics and presentation of wetland values will be most useful</p> <p>Coordinate wetlands economic and valuation issues across ESRP-Wetlands projects, place-based projects, ESRP-Decision Support projects, and EXRP-Human Wellbeing projects and valuation</p> <p>Conduct valuation studies of core ecosystem services associated with wetlands, applying non-market techniques</p>
<p>Dr. George E. Henderson</p> <p>Formally a senior research scientist with Florida Fish and Wildlife Commission</p>	<p>Linking fisheries sciences and human resource utilization with traditional data to guide development of predictive and GIS Landscape models</p> <p>Tampa Bay, state fisheries and habitat research programs, and regulations and requirements governing these areas</p>	<p>Expert advice to the ESRP-Tampa Bay Pilot Project, identifying technical issues related to quantification and valuation of ecosystem services</p> <p>Leadership to Tampa Bay working group partners and liaison to insure effective and efficient communication among Tampa Bay work group partners, including Tampa Bay Estuary Program, Tampa Bay Regional Planning Council, state, county and local decision makers and federal partners</p> <p>Assistance and facilitation to the Tampa Bay Pilot working group in development of conceptual models, particularly in the area of secondary production, wildlife and fisheries functions and services.</p>
<p>Dr. Stephen Polasky</p> <p>U. of Minnesota</p>	<p>Biodiversity conservation</p> <p>Endangered species policy</p> <p>Integrating ecological and economic analysis, ecosystem services, renewable energy, environmental regulation, and common property resources</p>	<p>Expert advice to the ESRP-Willamette Ecosystem Services Project (WESP) to determine the best approaches to economic valuation of ecosystem services</p> <p>Facilitate collaboration between WESP and the Natural Capital Project, a joint effort by Stanford University, The Nature Conservancy, and the World Wildlife Fund in planning, methods and data sharing, and research activities</p> <p>Complete a report that summarizes the options for WESP to work with and provide data to economists for valuation assessments, proposes one or more courses of action to achieve these options, and recommends the best option for WESP</p>

		to pursue.
Dr. Kenneth H. Reckhow Duke U.	Water quality modeling and environmental management Decision analysis and risk Sensitivity and uncertainty analysis	Expert advice and council in development of an innovative strategy to track and forecast ecosystem services Liaison between the Monitoring, Modeling and Mapping team and other ESRP teams to assist in the convergence of methods related to economics, decision analysis, risk analysis, and modeling Guidance and assistance in planning, developing, and defending the ESRP modeling strategy to peer scientists and to high-level EPA decision makers
Dr. Amanda P. Rehr Carnegie Mellon U.	Environmental modeling and software programming Sensitivity and uncertainty analysis Human behavioral, economic, and social dimensions of environmental impacts and risk	Expert advice and council to the ESRP Decision Support Platform Team in developing an on-line decision support platform that provides the user the ability to integrate, visualize, and maximize use of diverse data, models, and tools at multiple scales to generate alternative decision options and understand the consequences of management decisions on the sustainability of ecosystem services, their value and human well-being Liaison between the Decision Support Platform team and other ESRP teams to assist in translating data and information across various types and levels of expertise Develop models and a web-based tool for assessing the decision landscapes of environmental management problems Demonstrate decision landscape models using case study examples real use cases of decision processes of decision makers Demonstrate the use of uncertainty analysis on the expected benefits and costs of decision options and value of information analysis based on additional research or monitoring in order to reduce uncertainty and resolve conflicts
Dr. J.B. Ruhl Florida State U.	Environmental law Geography Wetlands regulation Environmental impact	Assist in developing an integrated ESRP research plan that will withstand peer review by international peers Assist in defending the ESRP plan and responding to peer comments Identify new advances in Ecosystem

	<p>assessment</p> <p>Endangered species</p> <p>Land use regulation</p>	<p>Services (ES) made internationally that are relevant to the ESRP and changes in plans and directions to incorporate these recent advances</p> <p>Identify similar efforts internationally which have interests similar to the ESRP, recommend opportunities for collaboration, and facilitate development of mutually beneficial partnerships</p> <p>Review existing statutes for a) how ES are interpreted at present, b) how ES may be incorporated via administrative rule-making, and c) how ES may be incorporated via statutory changes</p> <p>Describe how existing law may provide a basis for documenting explicit consideration of ES in decision-making</p> <p>Describe the potential for new scientific results and ecological knowledge to inform new interpretations of public trust doctrine, property law, and implementation of precautionary principle</p>
<p>Dr. James Sanchirico</p> <p>U. of California, Davis</p>	<p>Coral reef ecosystem valuation</p>	<p>Advise ESRP Coral Reef Research Team re: technical issues related to quantification and valuation of coral reefs</p> <p>Provide an initial description of a socioeconomic model a) incorporating economic valuation concepts based on total economic value, b) including mechanisms to forecast changes in local economic values from changes in coral reef condition in the eastern Caribbean, and c) integrates fishery harvests, fishing pressure, tourism, shoreline protection, and biodiversity</p> <p>Assist the Coral Reef team to design and refine a model for examining relationships among fisheries, tourism, shoreline protection and biodiversity of coral reefs with local social and economic activity</p>
<p>Dr. Gurpal Singh</p> <p>U. Florida</p>	<p>Environmental fate and transport of nutrients and chemicals in agricultural ecosystems</p> <p>Geographic Information System treatment and analysis of agricultural data</p>	<p>Advise the ESRP Tampa Bay Pilot Project re: a) technical issues related to quantification and valuation of agricultural ecosystem services with a focus on stressors identified in conceptual maps and their effects on functional values in agricultural ecosystems</p> <p>Assist the Tampa Bay Pilot working group</p>

		<p>in developing conceptual models, particularly in the area of agriculture and their functions and services and connectivity to other ecosystem components such as wetlands, forests, and urban ecosystem/landscapes.</p>
<p>Dr. Peter J. Shuba</p> <p>Strategic Planning Services</p>	<p>National coral reef business model</p> <p>Quality management and improvement</p> <p>Biological sciences</p>	<p>Assist in the ESRP Coral Reefs client needs assessment process</p> <p>Provide business intelligence for ESRP Coral Reefs by a) conducting task analyses to identify, capture and leverage information about client business operations and b) identifying opportunities for product development (e.g., indicators, protocols, Decision Support Platform, etc.) to ensure that ESRP Coral Reefs products provide value to clients</p> <p>Develop and implement an effective strategy for ESRP interaction with clients</p> <p>Coordinate service delivery to the client to achieve strategic client objectives by a) assisting in overcoming client resistance to change and b) helping clients clarify their common interests and work through differences more productively</p> <p>Develop concepts and strategies for client outreach and market development initiatives that may benefit the ESRP nationally</p>
<p>Dr. Mitchell J. Small</p> <p>Carnegie Mellon U.</p>	<p>Modeling environmental fate, transport, exposure, and risk</p> <p>Environmental statistics</p> <p>Methods for sensitivity and uncertainty analysis</p> <p>Human behavioral, economic, and social dimensions of environmental impacts and risk</p>	<p>Expert advice and council to the ESRP and to the ESRP Decision Support Platform in the area of decision support to support and inform the development of an innovative, on-line decision support platform that offers users the ability to integrate, visualize, and maximize use of diverse data, models and tools at multiple scales to generate alternative decision options and understand the consequences of management decisions on the sustainability of ecosystem services, their value and human well-being</p> <p>Identify methods and computer tools for a) predicting human health and ecosystem impacts, natural resource damages, and sustainability of energy and material resources, b) economic valuation of the environmental and human health impacts, c) sensitivity and uncertainty analysis of</p>

		<p>impact and valuation estimates generated, d) generating management alternatives for environmental problems, e) decision analytic evaluation of management alternatives, f) determination of value-of-information associated with new monitoring, experiments, studies, and research</p> <p>Application and comparison of methods using two or more case studies</p> <p>Liaison between the Decision Support Team and other ESRP teams to assist in the convergence of philosophies related to economics, decision analysis, risk analysis, and modeling</p> <p>Guidance and assistance in planning, developing and defending the ESRP decision support platform to peer scientists and high-level decision makers</p>
<p>Dr. James H. Thorp U. of Kansas</p>	<p>Aquatic ecosystems</p> <p>Conceptual, descriptive, and experimental research on non-wadeable river systems</p> <p>Hydrogeomorphic and ecological character of riverine ecosystems</p>	<p>Assist in development and refinement of a method for ecologically-based classification of riverine habitats that directly supports the determination of ecosystem services provided by these ecosystem assets.</p> <p>Verify the spatial scale at which remotely sensed variables should be measured to best estimate ecosystem services provided</p> <p>Identify which, if any, additional environmental variables are needed to supplement those remotely sensed parameters</p> <p>Evaluate and demonstrate the classification procedure on multiple basins in different ecoregions to assure applicability of the approach for application at the national scale</p>
<p>Dr. Liem T. Tran U. of Tennessee</p>	<p>Environmental integrated assessment</p> <p>Environmental and physical geography</p> <p>Decision-making science</p> <p>Geographic Information Science</p> <p>Spatial/quantitative analysis</p>	<p>Assist ORD's Future Midwestern Landscapes Study project team in the construction of the "Multiple Services" future scenario for a 13-state area of the Midwestern U.S.</p> <p>Develop an Analytical Hierarchical Process model at regional scale to capture the multiple levels and multiple components of "Multiple Services" as well as the relative values of each service versus the others</p> <p>Develop a multi-organizational model to</p>

		<p>evaluate various future scenarios with respect to multiple objectives and multiple criteria.</p> <p>Assist in development of a watershed-based economic model and land-use change model</p> <p>Assist in development and effective use of the Future Midwestern Landscapes-EDT and ensuring the EDT is able to contrast the Multiple Services Scenario with the Base Year Scenario and the Biofuels Target Scenario, to highlight the differences between these scenarios, and to identify gaps in the provision of ecosystem services.</p>
<p>Dr. Charles J. Vorosmarty</p> <p>U. of New Hampshire</p>	<p>Measuring, modeling, and mapping of hydrological and biogeochemical ecosystem services</p>	<p>Expert advice to resolve technical issues related to estimation, model simulation, and field-based and remotely-sensed monitoring of a suite of water-related ecosystem services</p> <p>Advice on methods to assess water-related ecosystem services that will a) be focused on the Nation as a whole, b) form a national partnership to define key research needs and products, c) promote trans-boundary perspectives on technical issues, d) specify steps for producing a prototype national system for estimating water-related ecosystem services</p> <p>Leadership in making technical modifications to the ERP Multi-Year Plan and to individual implementation plans in response to peer comments</p> <p>Identify similar activities and organizations world-wide, with activities similar to those of the ESRP, recommend specific opportunities for collaboration, and facilitate development of mutually beneficial partnerships</p>
<p>Dr. Lisa A. Wainger</p> <p>Chesapeake Biological Lab</p>	<p>Valuation and mapping of ecosystem services</p> <p>Integrated ecological and economic analysis</p> <p>Risk analysis and decision-support tools</p> <p>Ecological and economic indicators</p>	<p>Assist the Future Midwestern Landscapes (FML) Study project team in constructing a "Multiple Services" future scenario for a 13-state area of the Midwestern U.S. Gather and manipulate spatially-referenced agricultural and ecological data sets, estimating ecological production functions, employing valuation approaches, and modeling landscape change</p>

	<p>GIS-based modeling and spatial statistical analysis</p> <p>Statistical modeling including time series and multivariate techniques</p>	
<p>Dr. Peter B. Woodbury Cornell U.</p>	<p>Plant science, plant pathology, and environmental toxicology</p> <p>Ecological Risk Assessment</p> <p>Uncertainty analysis</p> <p>Nutrient loadings to watersheds</p> <p>Greenhouse Mitigation</p> <p>Ecological implications of bioenergy systems</p>	<p>Assist the Future Midwestern Landscapes (FML) Study project team in “scoping” the causal pathways by which future land use changes in the Midwest may be expected to alter the provision of ecosystem services. This will involve the conceptual mapping of these pathways and, based on a survey of the current literature on ecology and bioenergy development, determination of the sign and order of magnitude of the changes expected as well as the level of certainty attached to that expectation</p> <p>Advise the FML Team on methods for the analysis of the uncertainties that are propagated through complex systems of linked models employed by the FML</p>
<p>Dr. David W. Yoskowitz</p>	<p>Ecosystem services identification, given land cover and estuarine and marine habitat</p> <p>Survey sampling to support ecosystem valuation involving both stated and revealed preference approaches</p> <p>Economic impact analysis via input-output modeling</p> <p>Parametric & non-parametric statistical analysis for ecosystem services valuation & description</p>	<p>Evaluate the potential and approach for economic valuation of ecosystem services in Tampa Bay, utilizing existing data and identifying data gaps</p> <p>Map valuation techniques to identified landscape and ecosystem services identified with that landscape</p> <p>Integrate valuation of ecosystem services, at the latter stages of the development of the ecological response functions, using benefit transfer methodology</p> <p>Develop an implementation plan assessing the relationship between ecological function and the value of ecosystem services for Tampa Bay</p>

Appendix E: Public-Private Partnership for National Ecosystem Services Research

Opportunity for Participation

The Ecosystem Services Research Program (ESRP) at the United States Environmental Protection Agency (EPA) is seeking partners for a National Ecosystem Services Research Partnership. The Partnership goals are to:

- 1) establish ecosystem service standards and measurement protocols that support environmental accounting systems and markets,
- 2) advance ecosystem service valuation techniques,
- 3) create institutional capacity for investments in the natural capital that provides sustainable flows of ecosystems services, and
- 4) improve the ability to perform ecosystem service assessments across institutional, spatial, and temporal scales.

One possible action for the Partnership is to establish multiple Centers of Excellence that can host long-term inquiry in particular geographic areas with unique challenges and implementation opportunities, such as large metropolitan centers, coastal areas, or other biogeographically or politically-defined regions. The participants, organizational structure, responsibilities, and funding opportunities will be determined in collaboration with interested parties through future communications, including meetings, telephone conferences, and correspondence. The purpose of this announcement is to identify interested parties from the governmental, non-governmental, and private sectors interested in pursuing a multi-disciplinary, multi-institutional, national research partnership.

Overview

Ecosystem services are vital for public health and the well-being of human communities. Improved understanding of ecosystem services across institutional, spatial, and temporal scales is crucial for designing management strategies and institutional and governmental policies intended to increase and sustain the value of ecosystem services. The EPA, the ESRP is focused on understanding the present and future ecological dynamics of ecosystem services to create a solid scientific foundation for environmental decision-making. Approximately 200 EPA scientists with an annual in-house budget of \$62 million are associated with this program and will participate in the Partnership; EPA funding will primarily support this in-house research effort. For more information on the ESRP, please visit <http://www.epa.gov/ecology/>.

The Partnership will join not only ecology and economics, but also law, public policy, and business, among other disciplines. The ESRP proposes a three-part framework to understand ecosystem services research: 1) the ecology frame, 2) the economic-ecologic frame, and 3) the institutional frame. The ecology frame focuses on the biophysical characterization of ecosystem functions and services, seeking to make multidimensional, multi-scalar phenomena quantifiable using methods that are replicable across contexts. The economic-ecologic frame consists of work at the interface between ecology and

economics, often using joint economic-ecological models to characterize production relationships between ecosystem status and the delivery of economically valuable services. The institutional frame emphasizes law, policy, and business research to enable routine, operational investments in ecosystem services.

The ESRP core research strength is in the ecology frame. ESRP research products (e.g., ecological methods, data, maps, and models) will be EPA's primary contribution to the Partnership. We seek feedback from all potential partners on ways to make our research products more valuable for decision-making within the public and private sectors. We encourage others to use this Partnership to critique, refine, extend, and apply ESRP research in novel ways, including branding, investment standards, marketing, or other approaches that can create revenue streams from ecosystem service investments.

The ESRP is also using strategic partnerships to advance its work within the economic-ecologic frame. Establishing a research focus within the institutional frame is of the utmost importance to the ESRP, and we especially seek partners to advance this area. Institutional approaches will necessarily draw upon research from the ecology and economic-ecologic frames. They must also respond to a different set of challenges related to the design of institutional policies and instruments required to enable significant private, public, and municipal sector investments in the protection and restoration of ecosystem services.

Invitation

We invite interested organizations, public or private, to participate in this exciting research and development venture with EPA through a Cooperative Research and Development Agreement (CRADA) or other appropriate instrument (e.g., Memoranda of Understanding and/or Interagency Agreements). For more information on CRADAs, the most probable instrument, please see the website: <http://www.epa.gov/osp/ftta.htm>.

To indicate interest

Please reply in an email to Alexander Macpherson (macpherson.alex@epa.gov) by February 15, 2009 if you are interested in pursuing participation in this research partnership. In your response, please provide the following information:

1. Name and address of your organization
2. Name, address, telephone number, and email address of organization's contact person
3. Area(s) of research that most interest your organization;

Next Steps

Early in 2009, the ESRP will convene the first of a series of meetings that will include respondents to this announcement to refine the vision, objectives, and next steps for the Partnership. Meeting participants will discuss issues such as 1) membership and organization of the Partnership, 2) participants and their responsibilities, and 3)

developing a multi-year research strategy, and 4) developing a funding strategy that leverages EPA's in-house investment. We will incorporate the perspectives and insights from this meeting to refine and formalize the Partnership, its representatives, their responsibilities, and its research and funding strategy.

For technical questions and issues, contact Iris Goodman (202-343-9854, goodman.iris@epa.gov) or Alexander Macpherson (919-541-9770, macpherson.alex@epa.gov).

Appendix F: Expanding Environmental Protection: Supplying Ecosystem Science in Support of Ecologic and Economic Sustainability

Investment Description

EPA's mission has always been to "protect human health and safeguard the natural environment upon which life depends." This foreshadows today's interest in the interdisciplinary science of ecosystem services. Ecosystems provide clean air, climate regulation, water quality and quantity, food, fuel, productive soils, recreation, and culturally important natural areas. Provided "free" by nature, these services are currently undervalued in environmental management decisions, resulting in their rapid depletion. In banking terms, we are greatly overspending our natural capital. In 2005, the Millennium Assessment estimated that 15 of 24 critical ecosystem services are in decline worldwide.

Despite 39 years of progress, EPA faces ever more complex challenges. Numerous issues and interest groups vie for attention while budgets for environmental protection continue to fall in the depressed U.S. economy. We currently have no systematic guidelines with which to design EPA policies and incentives to promote needed ecosystem investments and set priorities for implementation. In part, this is a legacy of piecemeal U.S. environmental law, which – although visionary in its conception and early implementation – is now yielding diminishing returns with respect to desired environmental outcomes.

This investment proposal will expand the Agency's effective budget for environmental protection by creating a systems approach to enable routine investments from the private and public sectors to go beyond compliance to create new financial, social, and natural capital (i.e., enhanced ecosystem services). Businesses, municipalities, landowners, and states will realize multiple environmental and financial benefits – even diversified revenue streams – by strategically modifying existing expenditures for environmental management, and creating opportunities to develop appropriately designed new markets for ecosystem services. This approach builds upon the Agency's historic emphasis on minimizing the impacts of pollutants (i.e., negative externalities) to create new ways to enhance the services we receive from functioning ecosystems, in ways that create new economic wealth and better addresses social equity (i.e., positive externalities). Not only is this approach more balanced, it will also "create demand" for ecological integrity by rewarding stewardship and by connecting with the public on issues of social well-being and equity.

Ecosystem services are the evolving currency of environmental protection; technological and regulatory solutions alone cannot suffice for complex problems. Moreover, natural capital appreciates over time; built capital often rapidly depreciates. A blend of natural and built capital will provide the greatest resilience over the long-term, but defining this blend is neither obvious nor trivial to implement – especially in real communities.

This proposal will develop guidelines to 1) provide ways to systematically assess economic, financial, and environmental effects of decisions; 2) compare environmental

and social tradeoffs associated with alternative management strategies; 3) use scenario analyses to avoid unintended consequences; 4) implement monitoring frameworks to empirically document performance vis-à-vis changes over time in a suite of U.S. ecosystem services over time; and 5) develop tools to prioritize investments that combine the best of natural systems and technological innovations to reduce impact.

We can most swiftly create a new generation of innovative environmental policies by teaming with the Office of Air and Radiation, the Office of Water, the National Center for Environmental Statistics, the National Center for Environmental Economics, EPA’s Office of General Counsel, Regional Offices, and the Administrators Office of Environmental Education. Immediate opportunities also exist to implement current regulations in ways that reflect new scientific knowledge about ecosystem services, such as in rules implementing CAA, CWA, CERCLA, and NEPA.

This proposal builds upon ORD’s Ecosystem Services Research Program (ESRP), which has received excellent reviews and encouragement from three separate EPA SAB Committees. We propose the following activities to complement current ESRP funding in ORD, much of which expands Agency participation:

-- *Facilitating institutions, policies, and market structures for the future:* (a) Regional Centers of Excellence, (b) Expanding the Community of Practice, (c) Partnership Incentives, (d) National Public Private Partnership for Ecosystem Services(see appendix D)

-- *Demonstrating and testing the value of the ecosystem services approach:* (a) Regional Projects, (b) Applying ecosystem services decisions to alternative energy policy and to green infrastructure projects.

-- *Fundamental Tool Development:* (a) Mapping Ecosystem Services, (b) Modeling Ecosystem Services Responses, (c) Monitoring Designs and Metrics, (d) Decision Support Platforms

-- *Reaching the Current and Next Generation* – to educate the next generation of transdisciplinary environmental professionals and to effectively communicate ecosystem service concepts to a broad audience of decision makers today, the public, and children.

Program Component	FTE	Funding M)
ORD	50	74
Regions	50	30
National Center for Environmental Economics	10	5
Office of Air and Radiation	20	10
Office of Water	40	20
Office of General Council	2	1
Office of Environmental Information	5	5
Environmental Education	5	5

Appendix G: ESRP and the Office of Air Quality, Planning and Standards: draft and evolving commitment for collaboration

Description of OAR Science-Policy Liaison to ORD's Ecosystem Services Research Program

Background:

EPA-ORD's Ecosystem Services Research Program (ESRP) is a new, multi-year research initiative currently underway. The overall goal of the ESRP is to transform the way decision-makers understand and respond to environmental issues, making clear the ways in which their policy and management choices affect the type, quality, and magnitude of services we receive from ecosystems. The ESRP has chosen to focus on reactive nitrogen for pollutant-specific research, which aligns with Program Office needs across the Agency.

Need:

In order to achieve this goal, it is necessary for Program Offices and ORD to have a shared understanding of the programs, policies, and research needs and interests across the Agency.

Objective:

To ensure that ESRP research is aligned tightly with Program Office needs, such that research is focused in ways that can be used to answer policy-relevant science questions from Program Offices. This objective is consistent with and supports the objective of enhancing the effectiveness and value of ORD research to Agency needs.

Specifically, the Office of Air is addressing nitrogen pollution through the secondary NO_x/SO_x NAAQS review and is exploring ways to address nitrogen pollution in the Chesapeake Bay (via Executive Order on Chesapeake Bay Protection and Restoration 5/12/09). ESRP reactive nitrogen research can be of substantial value to these efforts when guided by a clear understanding of OAR's policy objectives.

Roles and Responsibilities:

The OAR Science-Policy Liaison to the ESRP will play a key role in helping to ensure that current and future research efforts address Program Office needs. The primary task of the Science-Policy Liaison is to ensure that research directions within ESRP will provide the science needed by OAR. In this capacity, the Science-Policy Liaison will attend ESRP meetings and workshops, review research projects, serve in a research coordination role, and ensure that the program directly addresses Program Office needs.

Specifically, the OAR Science-Policy Liaison will operate at the science-policy interface between the Nitrogen-ESRP and the Program Office. The Science-Policy Liaison will assist in guiding research directions and outputs toward the science-based policy needs of standards and voluntary programs, and communicating how the research products can and will be used by the Program Office. Additionally, the Science-Policy Liaison will participate in the leadership of all stages of the research process, including planning,

review, mid-course correction, and development of end products (e.g., databases, journal articles, etc.). In this capacity, the Science-Policy Liaison will be in the position to facilitate effective communication between the science and policy offices, thereby promoting the utility and effectiveness of the research program in a policy context. The Science-Policy Liaison also can serve as a spokesperson for the Nitrogen-ESRP, providing advocacy in appropriate contexts of the value of the research program to accomplishing the Program Office's mission.

As an example, OAR has a need to understand the relationships between critical loads for acidification and effects on ecosystem services for the next secondary NO_x/SO_x NAAQS review (2011-2016). The Nitrogen-ESRP is well-equipped to spearhead this effort in the near term. This effort will require input from a variety of perspectives including atmospheric and ecological science, valuation, and policy. The Science-Policy Liaison can take a leadership role in the planning and coordination, and an advisory role in the implementation of this effort to examine the ecosystem services associated with changes in acidity or other N impacts.

Commitments:

Support from both ORD and the Program Office is needed to make this cross-office interaction work effectively. The FTE for this position will remain in the Program Office; based on the understanding that time will be well spent in aligning research with Program Office needs. ORD can support this position by accepting the Science-Policy Liaison in a leadership role, and funding travel to ESRP events (meetings, workshops, conferences, etc.).

Appendix H: Selected ESRP Accomplishments 2007 – 2009

Goal 1: Effective Decision Support (human well-being, valuation, education and outreach, decision support systems)

Completed, demonstrated, and delivered web-based environmental decision toolkit for OAQPS

Developed the Watershed Deposition Tool to map gridded atmospheric deposition

Developed an approach for generating indices of biotic integrity for streams/ rivers in the western USA

Provided methods for using relative risk to compare the effects of aquatic stressors on biological condition at a regional scale

Estimated that the value of lost ecosystem services related to recreational angling in streams and small rivers of the Mid-Atlantic Highlands is \$148 M/ year.

Established an outreach and education program for the National Estuary Programs, in partnership with ORD Office of Science Policy, Columbia University and Region 2.

Presented ESRP's Decision Support Framework at the "Decision Analysis: Supporting Environmental Decision Makers Workshop. in a national Decision Support Workshop", Cincinnati, OH, March 2009

ESRP was used as an extensive case study at the BOSC's Decision Support Workshop, Cincinnati OH, April 2009

Goal 2: Mapping, Monitoring, and Modeling; including indicators

Executed an MOU with The National Geographic Society, as partner for disseminating ESRP ecosystem service maps. Early products have already been delivered.

Developed new GIS tools to better represent and model stream networks, including previously unmapped headwater streams.

Provided maps and analytical algorithms to screen for adverse effects on fish populations from development and aquifer drawdown near rivers. Now referred to in Michigan state legislature and used to implement its water protection laws. Similar programs under development in Wisconsin.

Established relationship between forest cover in source water watersheds and reduced costs for chemical and other treatment for drinking water in many U.S. cities.

In partnership, with U.S. Forest Service, established an association between urban forests and improved life expectancy, due to reduction of PM 2.5 by forest canopy.

Estimated the number of stream miles, both nationally and regionally, that have reduced nitrogen assimilation capacity. Greater than 50% of the nation's streams have lost much or most of their capacity to assimilate nitrogen.

Initiated a project to assess the effects of land cover and landscape pattern on drinking water quality in for approximately 5000 drinking water sources in the contiguous U.S.

Developed and demonstrated a new method for automated land cover change detection

Completed landmark study of pollutants in snow and aquatic systems in western national parks

Completed landmark study of mercury concentration in fish from western streams and rivers

Developed new suite of diagnostic response indicators in the Great Lakes coastal ecosystems

Developed cost-effective and logistically feasible methods for biological assessments of Great Rivers.

Developed model to characterize anthropogenic stressor gradients along the Mississippi, Missouri, and Ohio Rivers

Convened an ESRP in-house modeling committee to create a "community of practice" for modeling ecosystem services, including addressing issues of uncertainty and weight of evidence.

Goal 3: Nitrogen Assessment

A Program level Implementation has been completed and is beginning review. Implementation Plan includes preparation of a State of the Science report, identification of services affected by changes in reactive nitrogen, estimating nutrient loading, cases studies in nutrient cycling and ecosystem services, tipping points in ecosystem condition and services, and cross-place-based research on nitrogen removal (an ecosystem service) by river networks.

Improved the atmospheric model CMAQ to include the impact of sea salt on nitrogen deposition

The ESRP-N assessment is immediately supporting the ecosystem services approach adopted by OAQPS for their review of secondary NAAQS for NOX and SOX.

Goal 4: Ecosystem Type Projects: Wetlands and Coral Reefs

Wetlands:

Inserted ecosystem service endpoints in to FY 2020 EPA Great Lake Restoration Initiative and ecosystem service considerations into the Upper Lakes Study by the International Joint Commission.

Developed a new three-tiered approach for conducting wetlands assessment at watershed levels

Developed survey design framework for the first national assessment of wetland condition

Released a STAR solicitation: “Forecasting Ecosystem Services from Wetland Condition Analysis,” to examine how EMAP condition data can be used to assess wetland ecosystem services. Awards to be made late Spring 2009.

Coral Reefs:

Published a rapid bioassessment protocol for coral reefs to assess condition

Convened a needs assessment workshop for protection of coral reefs and ES in U.S. Virgin Islands

Developed the first ecological-socioeconomic systems approach for assessing coral reefs, i.e, the Drivers, Pressures, State, Impact, and Response (DPSIR) model. More than 30 coral reef experts from multiple institutions participated.

Goal 5: Place Based Demonstration Projects (Willamette, Tampa Bay, Midwest and Coastal Carolina)

Created new enhanced land cover for 12 states of the Midwest, that permit greatly improved estimates of nitrogen loads from these lands in conjunction with atmospheric nitrogen deposition and completed the initial landscape coverage to be used to simulate baseline conditions for the alternative scenarios for biofuels.

Using EPA’s Markal energy-emissions model and Iowa State University’s FAPRI system agriculture-sector model to iteratively specify future conditions projected to result from EISA’s biofuels targets.

Have developed a decision-analytic ecosystem services hierarchy (tied to biophysical measurements) for eliciting decision-makers preferences for a suite of ecosystem services across the study area.

EPA's Great Lakes National Program Office (GLNPO) is using Midwest Landscapes Environmental Data toolkit to prioritize management areas for improving water quality in Lake Michigan.

Michigan State University is using toolkit to identify research support to improve water quality across the region.

Released a STAR solicitation, co-funded with USDA, for modeling research to assess ways to enhance ecosystem services derived from agricultural landscapes.

An initial valuation of different ecosystem services was produced using a local relative valuation index we piloted in Tampa in December 2008 with a small set of local resource managers and scientists generally knowledgeable about ecosystem services. We infer from the results of this valuation pilot that the ecosystem services of water quality regulation, habitat functions, and freshwater supply may be of higher value than others including recreation, aesthetics, flood control, and climate regulation.

We are collaboratively producing a brochure with key Tampa groups to help them promote the concepts of ecosystem services.

New work underway to confirm that restoration of channels in the Willamette River will naturally cool heated discharges, sufficient to protect cool water habitat, as predicted by earlier ESRP geomorphological analyses. If confirmed, this will likely result in the first fully executed water quality trading program in Region 10, with savings potential in the many millions of dollars annually. Collaborators for the river restoration include researchers and decision-makers from: University of Oregon (UO); Oregon State University (OSU); The Willamette River Keepers; The Meyer Memorial Foundation (MMF); US Army Corps of Engineers (USACE); The Nature Conservancy (TNC); US Fish and Wildlife Service (USFWS); US Geological Survey (USGS); Oregon Department of Environmental Quality (ODEQ); the Oregon Water Enhancement Board (OWEB); Oregon Department of Fisheries and Wildlife (ODFW); the McKenzie Trust; City of Eugene, Oregon; City of Springfield, Oregon; Natural Resources Conservation Service (NRCS); EPA Region 10; Oregon Department of Parks and Recreation (ODPR); EPA Region 10; several private conservation organizations and clubs.