

# STAR REPORT

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To Achieve Results (STAR)

Research in Progress

8

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## ENVIRONMENTAL DECISION MAKING AND ECONOMICS

What methods are most accurate for determining the costs of environmental regulations? How can we best describe or measure the benefits of protecting environmental resources? How should we compare the value of preserving an environmental resource with that of developing it? These are the types of questions that are at the heart of EPA's environmental economics research.

Environmental policies and programs are intended to protect the health and well being of humans and ecosystems. Policies that protect the environment also provide

economic value and other benefits to society. Federal environmental laws typically require some economic analyses to be conducted by implementing agencies. The Clean Water Act requires economic impacts to be considered in developing point source discharge elimination requirements and in protecting wetlands to preserve ecological benefits. The 1990 Clean Air Act Amendments required EPA to assess the benefits of improved air quality. And the federal law regulating pesticide use mandates case-by-case risk-benefit analyses to balance farmers' and consumers' benefits from protecting crops against the potential for ecological harm. In recent years, policymakers at all levels of government have been increasingly asking for economic information to help them understand and evaluate the consequences of regulatory decisions. However, it is



widely felt by policymakers, economists and environmental scientists alike that available methods for evaluating the benefits and the costs of environmental protection do not provide all the information decision makers and the public want in judging the merits of proposed solutions to environmental problems. This report describes economic and ecological research supported by EPA's STAR program to meet the needs for cost, benefit and valuation information to support environmental decision making.

Methods commonly used by economists to measure public values include revealed or stated preference methods and contingent valuation. Representatives of the public are surveyed, or choices made by individuals or supported by the public in local government forums are determined, to learn how various types of environmental protection have been valued. Measures used by ecologists to describe the functions and services of healthy ecosystems are also central to valuing the benefits of environmental protection. Each of these types of approach are furthered by research supported by the STAR program. This report describes grants awarded from 1995 to 1998. The National Science Foundation (NSF) has joined with EPA to identify a related set of projects to be supported within NSF's Social, Behavioral and Economic Research program. Those NSF projects are also briefly noted at the end of this report, with more details available from the NSF Website at [www.nsf.gov/sbe/](http://www.nsf.gov/sbe/).

## ENVIRONMENTAL DECISION MAKING AND ECONOMIC RESEARCH IN EPA'S "STAR" PROGRAM

### Air Quality Benefits

In the eastern U.S., a multistate Ozone Transport Assessment Group (OTAG) conducts modeling and assessments to support regulatory decisions for the states' air pollution control programs. The **Georgia Institute of Technology** and a nonprofit Washington, D.C.-based research organization called **Resources for the Future** have a joint STAR grant to develop a model that will be used to search for efficient pollutant control programs, such as emissions or ambient trading, that could extend the OTAG modeling work by adding an environmental benefit component. The new work also treats economic cost and benefit factors, and the variables relevant to ozone formation processes, by incorporating uncertainty factors to simulate the unpredictable aspects of these variables (such uncertainty models are called "stochastic" rather than "deterministic"). Results are intended to help OTAG and others in eastern states better consider economic factors in analyzing alternate ozone reduction strategies. It is hoped that the data sensitivity analyses and uncertainty analysis will contribute to more precise model outcomes for regional ozone assessment.

**Duke University** has received a STAR grant to refine procedures for estimating the benefits of reducing air pollution in California taking into account geographic distributions of wealth, housing values and other community characteristics. Results are expected to help in evaluating the importance of localized conditions in



assessing overall pollution control benefits, and to provide new estimates of incremental benefits for reducing air pollution in Southern California that can serve as plausibility checks for EPA's effects-specific measures. Currently used benefits estimates monetize risk reduction with each specific effect treated independently, even though the sum may be more than an individual would be willing to pay for all the risk changes as a group. The new procedure is intended to avoid this problem by assessing peoples' willingness to pay for pollution reduction in the aggregate. The method will also allow comparisons of wealth and ethnicity profiles for schools and neighborhoods to those areas with greatest air quality

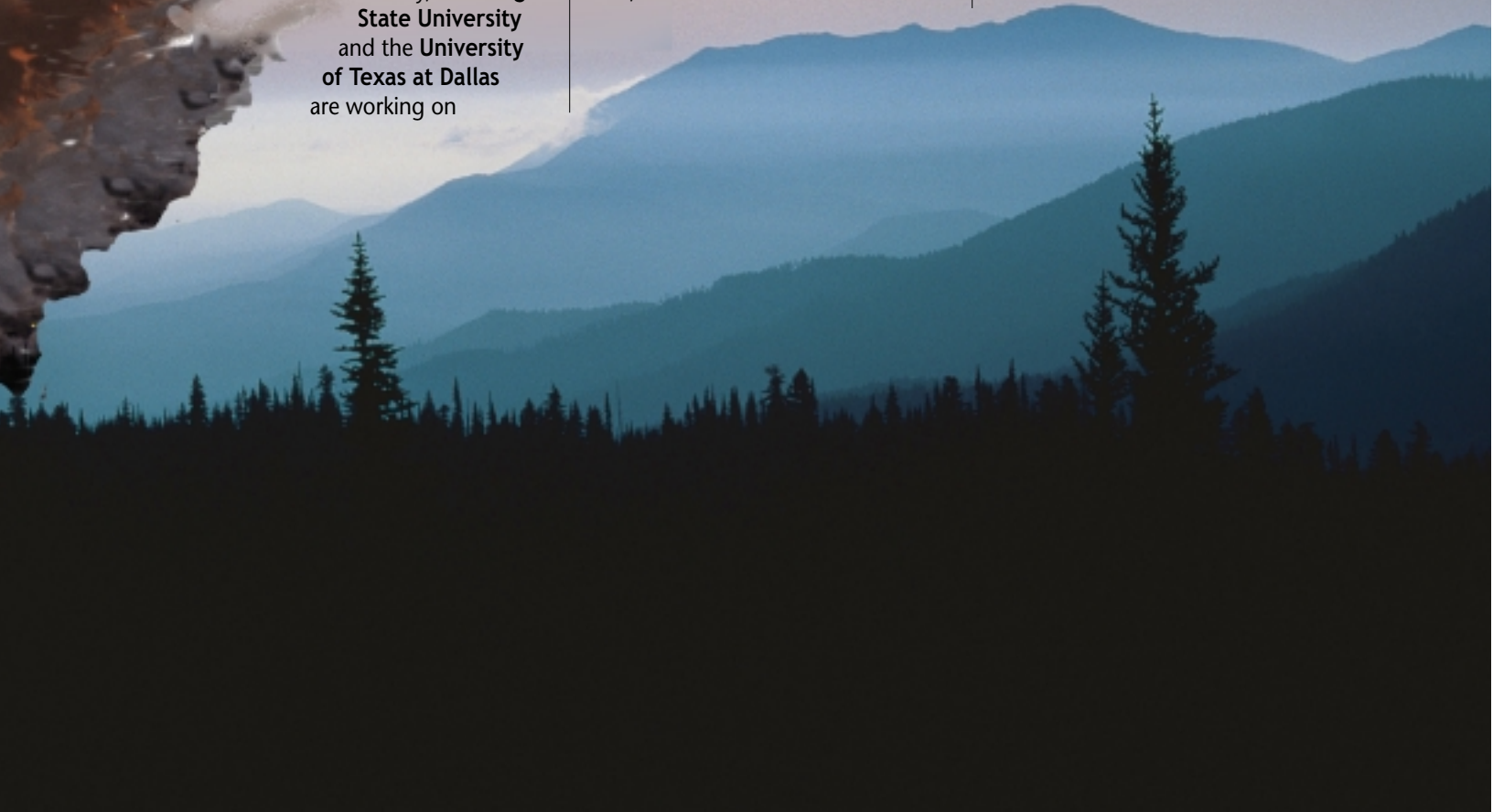
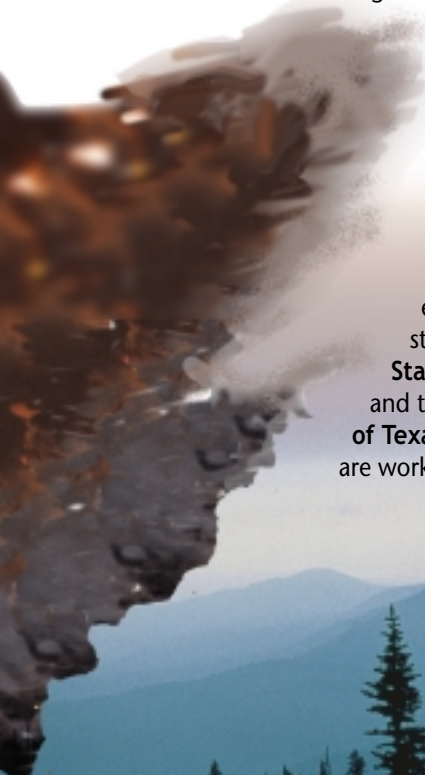
impacts, factors that are relevant to environmental justice considerations. In a second Southern California study, **San Diego State University** and the **University of Texas at Dallas** are working on

improving air quality benefit estimates by critically examining the relative importance of data aggregation, tradeoffs, and variations in space and time using an exceptionally large time-series data set. Data used are from the entire South Coast Air Basin, comprising Los Angeles, Orange, Riverside and San Bernadino Counties, and containing over one hundred cities, for the period 1980-1996. Willingness to pay estimates will be developed and a new procedure will be tested for estimating the effect of air quality on housing prices. It is expected that case studies developed here should be of use in benefits estimation for other locations.

There have been reports of cases in which taxes designed to further environmental protection have unintentional negative consequences because of taxed entities' responses to new taxes combined with pre-existing economic factors. Such factors can include other taxes that affect capital or labor costs. **Stanford University** is working with **Resources For The Future** to assess the effects of such "distorting taxes", and to recommend policy approaches that would complement, rather than work

against, economic forces in accomplishing pollution reduction. As an example, they will examine regulations affecting electric utilities. Results may help in the design of regulatory instruments that accomplish environmental protection goals while minimizing unintended costs of compliance. In another study relevant to electricity use, the **University of Maine** is reviewing survey data collected by the Department of Energy on the effects of "environmental labeling" of products on consumers' purchasing behavior. Factors analyzed will include the different label types, for example "environmental certification" or "disclosure". Researchers will assess the degree to which consumers find labels relevant, credible and easy to understand. Results will be differentiated according to respondents' socioeconomic characteristics; providing information regarding the impact of environmental labeling programs in different groups of people.

Reduced visibility in scenic areas is an impact of particular concern in air quality regulation. The **University**



of New Hampshire and the University of Massachusetts are joining with the Appalachian Mountain Club in research to determine how reduced visibility may affect the regional economy in New Hampshire's White Mountains. It has been speculated that deregulation of the electric industry could lead to degradation in air quality and visibility. This study will use two commonly applied valuation methods, contingent valuation and conjoint analysis (see final section of this report) to assess the likely impacts of visibility changes in the White Mountains on perceptions and economically-related activities of visitors to the region. This is described by economists as estimating the impact on the "consumer surplus" of recreational visitors. Results will be relevant to examining the cost implications of deregulation in this and other areas.

## Wetland Protection

The University of Rhode Island is modeling public preferences regarding forested wetlands, comparing potential economic returns from developing wetlands to amounts people have paid to preserve similar wetlands. In addition to providing data specific to

Rhode Island's wetlands decisions, these data will be compared to answers respondents have given to hypothetical questions concerning their "willingness to pay" to preserve wetlands in various places. This cross-checking of real expenditures with theoretical willingness-to-pay data will help researchers calibrate the realism of such theoretical data, which are widely used in estimating values the public holds for environmental resources.

In another wetland valuation study, Iowa State University is assessing values of restoring wetlands that are important for sustaining waterfowl, flood management and other ecological functions, as well as the non-monetary "existence value" of natural ecosystems to people with expressed interests in environmental conservation. This will provide a framework for combining the widely varying types of information available on such values: monetizable data such as expenditures on hunting and other human uses, information on people's wetland uses and travel to wetland sites, and theoretical willingness to pay surveys.

A third wetlands study by Johns Hopkins University focuses on optimizing the benefits of protecting specific wetlands because they contribute to migratory flyways for waterfowl. Available state and federal Geographic Information System wetlands databases will be used to identify wetland candidates for inclusion in a protected flyway system. Cost data, including approximate land values and wetland restoration costs, will be gathered and models will be formulated to evaluate alternate corridor configurations. Objectives that might be specified include minimizing corridor cost, maximizing the amount of habitat in the corridor, and ensuring a suitable geographic distribution of habitat. Tradeoffs between cost and habitat protec-

tion will be examined. Results will be relevant to the needs of the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service and other agencies that implement the North American Waterfowl Management Plan.

## Benefits of Protecting Surface Waters

In 1996, flooding occurred in the Pacific Northwest at levels unseen for three decades. In Salem, Oregon, high sediment loads due to the winter flood overwhelmed the municipal water supply's filtration capacity, halting water delivery. The city and major water customers incurred extraordinary costs to alter operations or obtain backup supplies. The watershed is heavily forested, and there is now debate over the extent to which logging and related activities led to the extraordinary sediment loads. Despite extensive assessments of activities affecting forest ecosystems in the region, there exists no full analysis of the downstream economic consequences of increased sedimentation. The University of Oregon is conducting such an analysis, attempting to establish correlations between upland forest management practices and the economic consequences of stream sedimentation for water supplies. They will estimate downstream costs due to sedimentation, and assess the contributions of land and reservoir management activities to sediment loads, providing their results for use by the state and municipal management authorities and public stakeholder groups that are actively addressing these issues in the region.

Values associated with improving the condition of southwestern streams, streambanks and rangelands are being studied by the University of New Mexico. Investigators will incorporate data on real payments made to protect some resources with information from focus groups and



*There is disagreement about how best to estimate improvements in property value expected to result from the cleanup of hazardous waste sites.*

other ways of asking about people's preferences. This study will include method assessment relevant to environmental valuation studies as a whole.

**Iowa State University** is examining approaches to modeling recreation demand in two case studies, one for the Wisconsin Great Lakes Region, and one for Iowa wetlands. Recreation demand models are used to value existing recreation facilities and in decisions affecting the numbers and types of recreation sites in an area. Two models will be tested with data sets from these two areas in an attempt to overcome problems that have been encountered in the past when such theoretical models have been tested in actual valuation settings. If the models prove workable, the advantage offered is a better ability to link together various factors relating to site selection, participation decisions and other aspects of recreational users' behavior, providing a behavior modeling framework that unifies factors previously modeled through cumbersome separate analyses.

### Contaminated Sites

The choice of a remedial strategy for a site with contaminated groundwater involves tradeoffs between the large expenses of action and the large and uncertain consequences of inaction -- consequences for health, for ecological quality, and for the availability of drinking water. The **Massachusetts Institute of Technology** is developing a decision analysis framework for groundwater remediation to help site managers deal with such tradeoffs. The choice of a strategy involves attitudes toward risk, the discounting of outcomes in the distant future, concerns for equity among outcomes at different times, and concerns for equity among the outcomes for different groups of people. The research brings together

recently emerging ideas from the natural and social sciences. Groundwater hydrologists are recognizing that slow mass-transfer processes between mobile and immobile material phases constrain rates of human aquifer remediation, but that slow natural degradation processes will tend to reduce organic contaminant levels over the long-term. Decision analysts are recognizing the importance of modeling social values to include significance to future generations and concerns for equity in the present day. This research will provide a framework for evaluating



alternatives for cleanup and containment, based first on information pertaining to a case study location, and then generalized into a model intended to be of use for national site remediation policy analysis.

**Michigan Technological University** and **Northern Michigan University** are also developing and testing new algorithms that would allow optimizing for multiple objectives in analyzing groundwater remediation problems. Objectives to be addressed include minimizing cost, risk and time, in the context of complex contaminated subsurface environments. The project will

produce a software tool based on a version of a mathematical model called a Niche Pareto genetic algorithm, which allows multi-objective optimization. It is hoped that resulting remediation designs will be significantly less expensive than those provided by traditional approaches.

There is disagreement about how best to estimate improvements in property value expected to result from the cleanup of hazardous waste sites. Previous studies typically have not assessed property values after cleanup has been completed, and may not take into account the effect of post cleanup stigma, in which an area may be clean and safe, but prospective buyer willingness to pay is still negatively affected. The **University of California at Berkeley** is assessing this effect in a study of housing values post-cleanup. They will develop an economic model of "hysteresis" (the tendency of values to return to previous levels) based on their findings of post-cleanup prices paid for residential real estate at varying distances from the cleanup location.

### National Accounts

The U.S., and all developed nations, regularly report data on national economic conditions, including such familiar "national accounts" as the gross national product (or gross domestic product), employment data, costs for goods and services, productivity and other statistics. However, neither the U.S. nor other nations report similar comprehensive statistics on the values to society of natural resources, or the loss of value when such resources are damaged by pollution, land development and other human impacts. Such national accounts of natural resource values are not yet widely reported in part because of a lack of agreed upon methodologies for defining them. Two STAR program grants have been

awarded to economists developing ways to perform such valuations relevant to U.S. national accounts. The **University of Colorado at Boulder** is assessing which proposed national account revisions would be most useful for evaluating overall impacts on social welfare of natural resource degradation. Factors to be considered include not only ways to evaluate the current stock of environmental goods, but also ways to predict future effects based on current man-made capital stock and potential technology advances, shifts in human preferences that may occur over time, and the fact that some potential environmental impacts would be irreversible. The **Colorado School of Mines** is specifically developing ways to estimate values of energy and mineral resources, so that additions to and depletions of these resources could be incorporated more accurately in national accounts.

### **Industrial and Household Pollution Prevention**

The economic benefits of pollution prevention and other innovative industrial approaches are assessed by several STAR grants. The **University of Rhode Island** and **Woods Hole Oceanographic Institute** have a joint project to estimate potential cost savings of technological innovation in offshore oil drilling operations. An historical analysis of offshore oil practices will provide the baseline for developing scenarios of potential future productivity changes and impacts of innovation. The model will be linked to various types of environmental regulation, including market-based approaches, to explore their implications for encouraging innovation, pollution prevention and improvements in productivity. A notable feature of this model lies in identifying the significance of technological advances as well as more subtle process changes, which can have major effects on process efficiency, waste production and management needs, and overall economic productivity of an operation.

The **University of Utah** is taking advantage of construction of a new Salt Lake City/County Household Hazardous Waste Facility to study attitudes and behavior change of household members concerning not only proper disposal, but also proper use of hazardous materials, including reduced use and proper storage for extended shelf life. The project will test a combination of individual persuasion and small group involvement techniques, including pamphlets, meetings and discussion groups. The importance of understanding and influencing a community's shared values is a major focus. If successful, techniques developed can serve as a model for other communities interested in reaching large numbers of citizens to optimize the environmental and economic efficiency of their household hazardous waste management programs.

### **Biotechnology**

The **University of California** at Berkeley is assessing potential benefits associated with developing new or cheaper products using biotechnology. This will be integrated with existing efforts to estimate economic benefits of preserving biodiversity, which protects the existing stock of genetic resources. It is hoped this may provide a more comprehensive economic approach for valuing biodiversity as well as the potential benefits of goods (medicines, crops, etc.) incorporating or derived from newly engineered genetic materials.

### **Farmland Preservation Programs**

Ecosystem health and environmental quality depend in large part on the pattern of land use. Farmland preservation is one policy instrument that seeks directly to control that pattern. The **University of Maryland** is studying landowners' farmland preservation behavior. A profusion of farmland preservation programs in that state set the stage for an experiment that allows us to test how different features of such programs affect different landowners' decisions to sell development rights. They will assess the factors influencing whether landowners will participate in various preservation programs. A second objective will be to predict the ecological consequences of the farm preservation programs, using generally agreed upon indicators that reflect environmental quality as influenced by land use patterns.

### **Public Values Concerning Health Risks**

**Duke University** and the **Research Triangle Institute** have received a STAR grant to study public values concerning human fertility risks that might be posed by some environmental contaminants. Typical valuation methods assess values of individuals. However, that may not be a complete way of assessing public concern about this issue, since it intrinsically involves values people hold as couples. This study will emphasize ways, using focus groups and other methods, of helping respondents describe their values concerning fertility risks so that feelings as individuals and as couples are incorporated in survey results. Results will be used to develop a



model of "household" decision making and values that would be relevant to environmental decision making concerning reducing possible fertility risks.

An interdisciplinary team from **Resources for the Future**, the **University of Maryland**, the **University of Colorado** and the **University**

They will estimate willingness to pay for risk reduction over an entire lifetime, with a particular emphasis on valuation of benefits that occur later in life. Results are intended to provide quantitative estimates to be for benefits assessments for a range of policy applications. Two thousand people are included in the study.

this approach promises to improve ecosystem management by creating a secondary information market for ecosystem services valuations.

Another ecosystem valuation grant, focusing on site selection procedures for biological reserves, has been awarded to a team from **Oregon State University**, the **University of**

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*For environmental protection and sustained economic growth to occur together requires ... common sense approaches that favor the most cost-effective ways to achieve our goals. EPA is committed to seeking the most cost-effective approaches by incorporating estimates of costs and benefits in strategic planning, where valid estimates of costs and benefits of economically significant regulations exist.....[EPA Strategic Plan]*

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**of Michigan** will combine economic and psychological methods to better understand how people evaluate the importance of the relatively tiny estimated mortality risks associated with environmental pollution. Results will be used to develop survey "instruments" (e.g., questionnaires) that help respondents more effectively provide, and policymakers more readily interpret, information on values relevant to very small risks of serious or lethal health impacts. In a related study, **Harvard University** and the **University of California at Berkeley** are working to improve procedures for assessing public values placed on avoiding health risks of varying severity. A common problem with valuation methods is that, when faced with standard contingent valuation questions concerning willingness to pay, people may say that they value avoiding even quite minor risks equally to preventing major risks. Researchers will test survey designs to improve ways of communicating about the magnitude of health risks, so that respondents better understand the risks when asked to evaluate reasonable costs to avoid them.

A team of researchers from **Resources for the Future**, the **University of Maryland**, the **University of Colorado** and the **University of Michigan** is testing two new survey instruments for estimating people's valuation of mortality risk reductions.

### **Ecosystem Valuation**

Despite tremendous progress in environmental protection over the last few decades, ecosystems remain under threat from the cumulative effects of remaining pollution sources and land development, and we lack agreed upon tools to assess the "ecosystem services" that are being lost as a result. A team of leading economists, ecologists and legal scholars from American University, Stanford University, the University of Maryland, Southern Illinois University and Indiana University has received a STAR grant to conduct case studies intended to bring together, test and widely disseminate the best current ideas on how to value ecosystem services in addressing some of the more widespread environmental management problems. Problems to be considered include contaminated site management, natural resource damages, which include wildlife declines, and efforts to mitigate destruction or degradation of wetlands. Products will include a practical users' guide for managers working in the field. This will provide instruction on using non-monetary valuation methods -- i.e. indicators -- focused on performance measures of local ecosystem services. The project will also provide an analysis of existing legal authorities that may allow a shift in focus of decision making processes towards the maintenance of ecosystem services. The research team feels

**Cincinnati**, the **University of Maine** and the **University of Idaho**. They will evaluate various technical factors for defining areas of greatest importance for conserving biological diversity. Factors assessed will include the probabilities of individual species' occurrence at sites, combined species coverages, and the validity of using such simple measures as proxies for more sophisticated diversity indices.

A large, multidisciplinary study to predict the linked ecological and economic effects of environmental protection in Maryland's Patuxent watershed is being funded by EPA and other federal programs, and conducted by a team from several universities and state and federal agencies. One component of this "Ecological Economics Patuxent Watershed Model", conducted by **Clark University** and the **University of Maryland**, is supported by EPA's STAR environmental economics program. They are developing ecosystem health indices relevant to the Patuxent area, and linking the ecosystem models to a pricing model that contributes to overall project predictions of economic implications of environmental protection options. This joint modeling effort will help economists and managers more fully consider the positive results of protecting watersheds through streamside buffer zones and other reductions in nonpoint source pollu-

tion, by providing better agreed upon ways of quantifying resulting improvements in ecosystem conditions.

Forest management is often considered as an option for reducing net human carbon emissions to reduce global warming. The **Ohio State University** is assessing the societal costs that might be entailed in storing carbon in forests through large-scale, global carbon sequestration programs. Previous studies have not considered the system-wide, dynamic effects that would result from global-scale managed forestry programs. Specific objectives are to model the marginal cost of carbon sequestration, develop a global forest carbon storage database, develop alternative strategies for forest carbon sequestration, and estimate costs. On a smaller scale, Oregon State University is combining biological and economic models for a Cascade Mountains forest to analyze land use problems to support forest management. Wildlife dynamics will be modeled with the widely used PATCH population simulation model, while a computerized search method, most likely also a genetic algorithm, will be used to describe optimal timber stand growth for given timber harvest objectives. The analysis will generate estimates of tradeoffs between timber production and species survival and between survival likelihoods for species within the set. And it will incorporate financial evaluation of timber harvest in a unified management framework. An advantage over previous approaches is that the conservation and economic tradeoffs will be identified over the full range of land management regimes, rather than for a limited set of alternatives

## Refining Contingent Valuation, Conjoint Analysis, Willingness To Pay Methods

A group of awards supports general methodology improvements, focusing on the meaning and reliability of commonly used ways of assessing public values for environmental protection. The **University of California at San Diego** will compare results of a number of such methods, including "willingness to pay" approaches among others. They will consider psychological factors such as risk preferences and responses to uncertainty about costs and benefits, and will assess how question and response formats affect survey outcomes. And they will consider how to address the concern that answers can be greatly affected by people's beliefs concerning how their answers will be used.

**Georgia State University** is testing contingent valuation survey designs, including eliciting answers to theoretical questions about values that more accurately mimic situations in which people actually pay for goods or services. **Carnegie Mellon University** is also evaluating alternative valuation techniques. Researchers there emphasize the need to help respondents answer questions about issues that may seem ambiguous and difficult to understand, or about impacts of uncertain scope or magnitude.

One method for assessing people's values for environmental protection without relying solely on monetary measures is called "conjoint analysis". The **University of Rhode Island** is using this type of analysis, developing and testing environmental valuation surveys using such innovative techniques as interactive multimedia computer presentations. They will try to modify standard economic assumptions to include psychological factors such as people being ambivalent, or having "fuzzy preferences", when confronted with decisions about environmental values.

An important concern in developing environmental regulations is how to measure the value of environmental resources to people who do not actively use them for readily measured benefits. "Active uses" such as fishing, boating and camping are often valued by determining the amounts people pay to enjoy them through daily use fees, and in paying for gear, traveling, lodging and similar costs. However, many feel that the value of protecting environmental resources goes well beyond such active uses, including significant "passive use" benefits to members of the public who want the resources to remain intact whether or not they actively use them. A team from **Cornell University**, **Princeton University**, the **University of California at Los Angeles**, the **University of Washington** and the **University of Colorado** is studying ways to obtain better agreed upon estimates of "passive use" values. Approaches include assessing public preferences as revealed in an on-going "green pricing program" in which customers of a New York power utility are asked to approve expenditures through public good auctions such as purchasing a landfill gas recovery project or planting a large number of trees. Another component of the study will be to analyze a psychological phenomenon in which survey respondents may have in mind environmental resource issues that are not the intended focus of a survey, so that their answers describe values they hold for resources other than those the survey addresses. This team includes researchers with differing predictions on how the public will respond to various types of question. It is hoped that this joint study will help provide statistically valid and



relevant data to help resolve some central methodological differences among researchers who work on passive use valuation.

A somewhat controversial type of valuation study asks respondents to evaluate their willingness to accept hypothetical monetary compensation for potential environmental impacts in their area. A team from **Duke University** and the **Research Triangle Institute** is assessing concerns about such studies, particularly that people react negatively to hypothetical proposals of cash compensation for environmental risks. The researchers will attempt to develop a value survey that would avoid such a negatively viewed alternative in obtaining input about values concerning facility siting decisions. As an example, rather than suggesting hypothetical financial compensation to individuals, a survey might ask about degrees of added public services, protections and/or amenities that would be considered to compensate for siting a new facility in a community.

Investigators from the **University of California at Irvine** and the firm **Decision Insights** are refining approaches to assess preferences when environmental decisions will have important long term consequences. "Discount factors" are typically applied by economists in valuing long-range future events, but more analysis is needed of people's preferences in order to expand previous research on discount rates from readily monetized consequences to many environmental non-monetized consequences.

A study by **Vanderbilt University**, in consultation with the Oak Ridge National Laboratory, addresses the concern that some values studies may bias responses by directly telling respondents that certain environmental resources are "good for" various recreational uses, rather than allowing people to judge for themselves the attributes they most value in selecting places to go for hiking, camping, sightseeing or other reasons. This study will use a battery of group and individual interviews to test ways of assessing values concerning forest environments. It is hoped that results will benefit estimation methods that are more defensible, and more complete in capturing the complexity of peoples' values regarding desirable aspects of ecosystems.

## EPA Research Awards Described in This Report

1998

Resources for the Future (DC) The Valuation of Mortality Risk Reductions: Application of Two New Survey Instruments

Duke University (NC) The Role of Locational Equilibria and Collective Behavior in Measuring the Benefits of Air Pollution Policies

University of Rhode Island (RI) Environmental Policy and Endogenous Technical Change: A Theoretical & Empirical Analysis

University of California at Irvine (CA) Assessing Preferences for Environmental Decisions with Long-Term Consequences

American University (DC) Market Valuation Models and Ecosystem Management in Making Legal and Policy Choices

Michigan Technological University (MI) Multi-Objective Decision-Making for Environmental Remediation

Iowa State University (IA) An Examination of Utility Consistent Approaches to Modeling Corner Solutions in Recreation Demand

Ohio State University (OH) Estimating the Cost of Carbon Sequestration in Global Forests

University of Maryland at College Park (MD) The Impact of Farmland Preservation Programs

University of Maine (ME) Environmental Labeling of Electricity: Label Design and Performance

Oregon State University (OR) Land and Management with Biological and Economic Objectives

1997

University of New Hampshire (NH) A Comparison of Direct Methods for Valuing Environmental Policies: A Case Study in New Hampshire's White Mountains

Massachusetts Institute of Technology (MA) A Decision Analysis Framework for Groundwater Remediation

University of Oregon (OR) Establishing Correlations between Upland Forest Management Practices and the Economic Consequences of Stream Turbidity in Municipal Supply Watersheds

Resources for the Future (DC) Cost-Benefit and Uncertainty Analysis for Ambient Ozone Reduction: Development and Demonstration of an Integrated Model and Framework

Dept. of Agriculture & Resource Economics University of California at Berkeley (CA) Stigma of Environmental Damage on Residential Property Values

Dept. of Geography and Environmental Engineering Johns Hopkins University (MD) Delineating Optimal Wetland Habitat Corridors for Inclusion in Migratory Flyways

San Diego State University (CA) Improving Air Quality Benefit Estimates from Hedonic Models

University of Utah (UT) Promoting Proper Use of a Household Hazardous Waste Facility: A Systems Approach

1996

Resources for the Future (DC) Effective Environmental Policy in the Presence of Distorting Taxes (additional funds from NSF)

Clark University (MA) Ecosystem Valuation: Policy Applications for the Patuxent Watershed Ecological-Economics Model

Harvard University (MA) Valuation of Risks to Human Health Insensitivity to Magnitude?

Iowa State University (IA) Updating Prior Methods for Non-Market Valuation A Bayesian Approach to Combining Disparate Sources of Environmental Values

University of Rhode Island (RI) Stated Preference Valuation Using Real Money for Real Forested Wetlands

Woods Hole Oceanographic Institution (MA) Decision-Making under Uncertainty in the Conservation of Biological Diversity

Research Triangle Institute (NC) Valuing Reductions in Environmental Sources of Infertility Risk Using the Efficient Household Framework

1995

University of New Mexico (NM) Preference Formation and Elicitation in Valuing Non-Market Goods

University of California, San Diego (CA) Comparative Studies of Approaches to Eliciting Economic Values

Georgia State University (GA) Valuing Environmental Damages with Stated Preference Methods New Approaches that Yield Demonstrably Valid Values for Non-Priced Environmental Goods

Colorado School of Mines (CO) Valuing the Stock and Flow of Mineral and Renewable Assets in National Income Accounting

Carnegie Mellon University (PA) Eliciting Environmental Values A Constructivist Approach

University of Colorado, Boulder (CO)  
Environmental Values and National  
Economic Accounts

Resources for the Future (DC) Mortality  
Risk Valuation And Stated Preference  
Methods An Exploratory Study

Duke University (NC) Improving  
Willingness-to-Accept Responses Using  
Alternate Forms of Compensation

University of Rhode Island (RI)  
Developing Conjoint Stated Preference  
Methods for Valuation of Environmental  
Resources Within Their Ecological  
Context

University of California at Berkeley (CA)  
Deriving Biodiversity Option Value Within  
a Model of Biotechnology Research and  
Development

Vanderbilt University (TN) Innovation in  
the Valuation of Ecosystems A Forest  
Application

Cornell University (NY) Can Contingent  
Valuation Measure Passive Use Values?

Related Research Supported by NSF  
[Environmental Decision Making]:

1997 [REDACTED]  
Georgia Institute of Technology (GA)  
Multi-Criteria, Dynamic, and Place-Based  
Approach to Ecosystem Valuation

Cornell University (NY) Demand  
Revealing Mechanisms for Contingent  
Valuation Validity Tests: An Experimental  
Approach Using Appropriate Populations

Vanderbilt University (TN) Citizen's  
Preference for Environmental Options:  
Evidence on Existence and Triggering

Cornell University (NY) Planned  
Behavior, Environmental Values and  
Domestic Water Conservation. A  
Longitudinal Case Study of the California-  
Nevada Truckee River Watershed

1996 [REDACTED]  
Decision Science Research Institute (OR)  
Distinguishing Values from Valuation in a  
Policy Relevant Manner

University of Maryland (MD) Aggressive  
and Deliberative Contexts for Valuation:  
A Philosophical Contribution to  
Experimental Research in Environmental  
Decision Making

University of Minneapolis (MN) Optimal  
Experimental Design for Conjoint  
Analysis

Resources for the Future (DC) The  
Transition to Green Technology:  
Implications of Irreversibility and  
Nonconvexity

Social Science Research Institute (MA)  
Factors Influencing Participation of Local  
Governmental Officials in Environmental  
Policy Making

Cornell University (NY) Policy, Norms  
and Values in Forest Conservation:  
Protected Area Buffer Zone Management  
in Central America

### General Information: The Environmental Protection Agency's STAR Research Program

Grants described in this report are part of EPA's Science to Achieve Results (STAR) program, a major research initiative designed to improve the quality of scientific information available to support environmental decision making. The STAR program is managed by EPA's National Center for Environmental Research and Quality Assurance in the Office of Research and Development (ORD). The program funds approximately 190 new grants every year, with the typical grant lasting three years. Funding levels vary from \$50,000 to over \$500,000 per year, with FY 1999 funding level at about \$95 million for grants to individual principal investigators or groups of investigators. Additional STAR funds are provided for a number of Research Centers specializing in scientific areas of particular concern to EPA, and for fellowship programs supporting graduate students conducting environmental research.



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