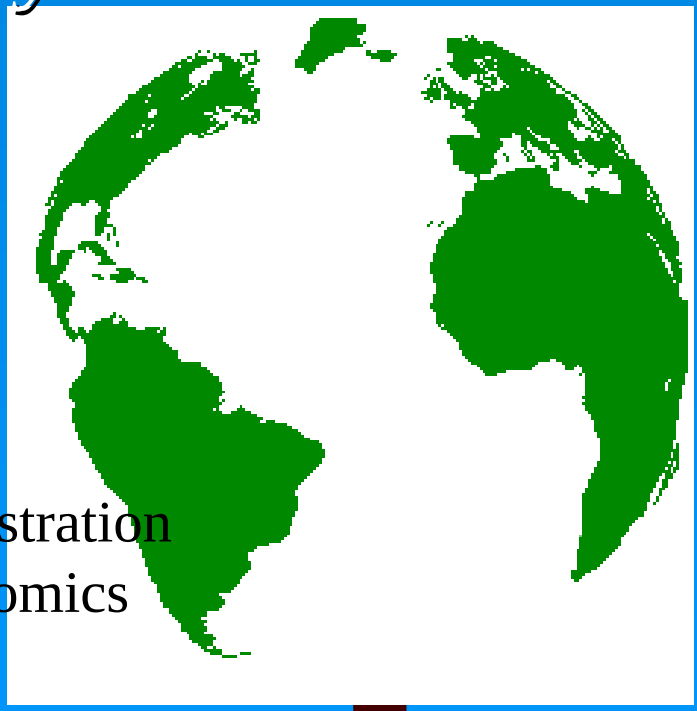
Accounting for Ecosystem Service Values in a Spatially Explicit Format: Value Transfer and Geographic Information Systems



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Past and Current Funding:

The State of Maryland Department of Natural Resources
Power Plant Assessment Division
Annapolis MD. 21041
http://www.dnr.state.md.us

The Northeastern States Research Cooperative (NSRC).
The George D. Aiken School of Natural Resources, at the University of Vermont and
USDA Forest Service Northeastern Research Station, Hubbard Brook Project.
http://www.uvm.edu/snr/nsrc/

New Zealand Foundation for Research Science and Technology (FRST)
Biodiversity, ecosystem services and sustainable agriculture Grant
Lincoln University, Christchurch NZ
http://www.frst.govt.nz/

State of New Jersey Department of Environmental Protection
Division of Science, Research and Technology
Estimating the Value of New Jersey's Natural Capital and Ecosystem Services
http://www.nj.gov/dep

The Presentation

I. **Conceptual Background on the Economic Geography of Ecosystem Services**
II. **The Valuation Database**
III. **Demonstration of the EcoValue Project© website**
IV. **Case Study Applications**
V. **Future Directions**

New Reference:

Wilson, Matthew A, Austin Troy, and Robert Costanza 2005. The Economic Geography of Ecosystem Goods and Services: Revealing the Monetary Value of Landscapes through Transfer Methods and Geographic Information Systems. In Dietrich and Van Der Straaten (eds.) *Cultural Landscapes and Land Use*. Kluwer Academic Publishers.

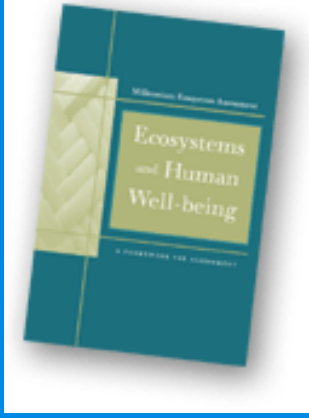
Exploring the Economic Geography of Ecosystem Services: New Horizons

Premise: Evaluating the distribution of *Ecosystem Service values* through the assessment of spatially explicit ecological and economic data offers one of the most defensible and viable platforms for benefits transfer today.

Goal: The EcoValue Project© provides academic researchers and non-commercial stakeholders with the ability to account for and track environmental service values in a customized, spatially explicit format. The system combines Geographic Information Systems (GIS) and relational database technology in order to:

- Link together available peer-reviewed economic valuation literature and ecological data in a transparent environment.
- Allow users to interactively generate maps, graphs and economic statistics for specific parcels of land at multiple scales

The Ecosystem Service Concept



Ecosystem services are the benefits people obtain either directly or indirectly from ecological systems (Millennium Ecosystem Assessment 2003). They include products such as food, fuel, and fiber; regulating services such as climate and water regulation and flood control; and nonmaterial assets such as cultural or aesthetic benefits (de Groot *et al* 2002).

http://www.millenniumassessment.org

DeGroot, Wilson and Boumans 2002 "A typology for the description, classification, and valuation of ecosystem functions, goods and services" *Ecological Economics 41(3*) pp. 393-420.

Millennium Assessment (MA) 2003 Typology of Ecosystem Goods and Services

Provisioning	**Regulating**	**Cultural**
Goods produced or provided by ecosystems	Benefits obtained from regulation of ecosystem processes	Non-material benefits from ecosystems
• food • fresh water • fuel wood • genetic resources	• climate regulation • disease regulation • flood regulation	• spiritual • recreational • aesthetic • inspirational • educational

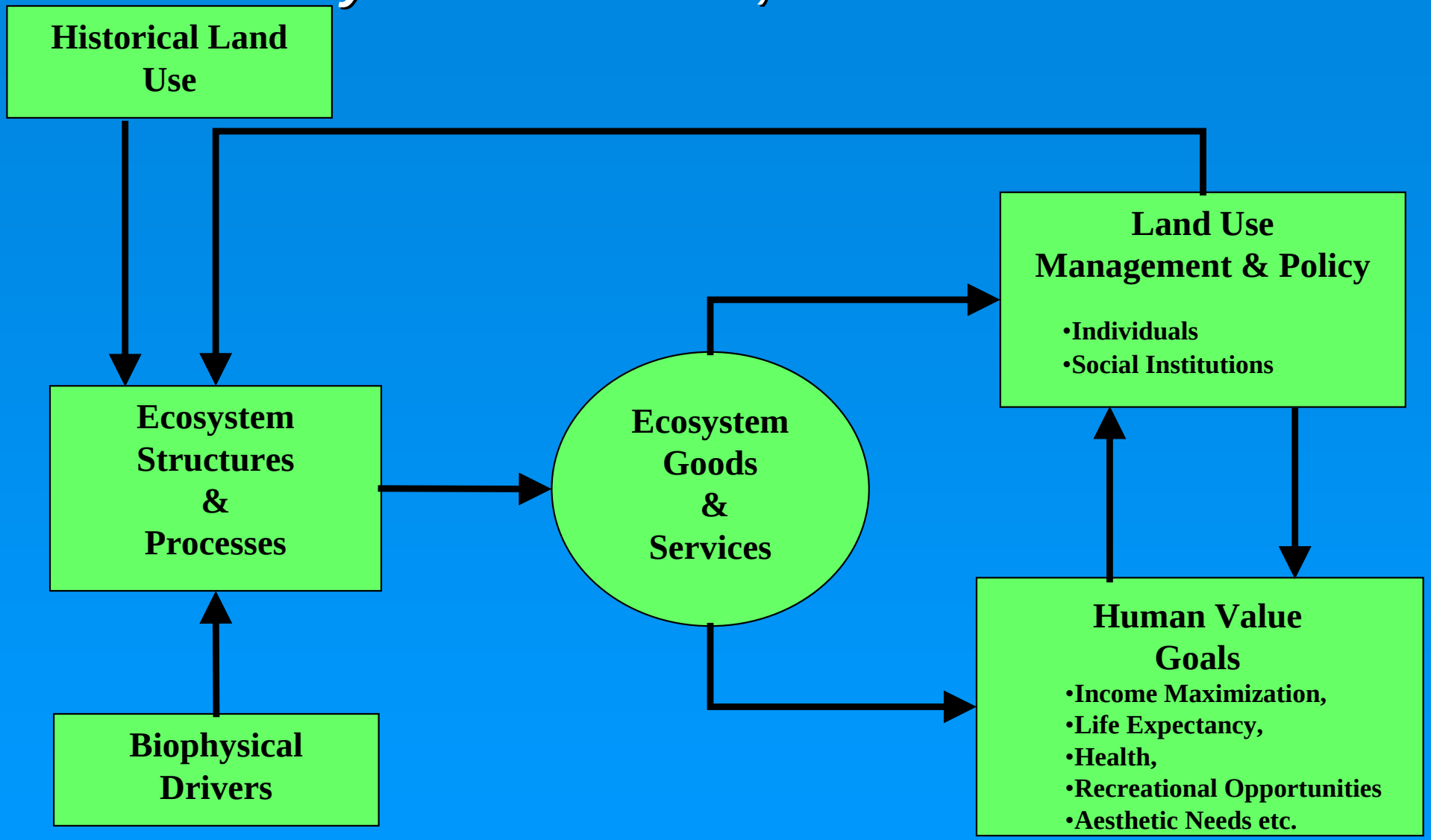
Supporting

Services necessary for production of other ecosystem services

- Soil formation
- Waste Treatment and Nutrient cycling
- Primary production

Adapted from Millennium Ecosystem Assessment *Ecosystems and Human Well Being* (2003)

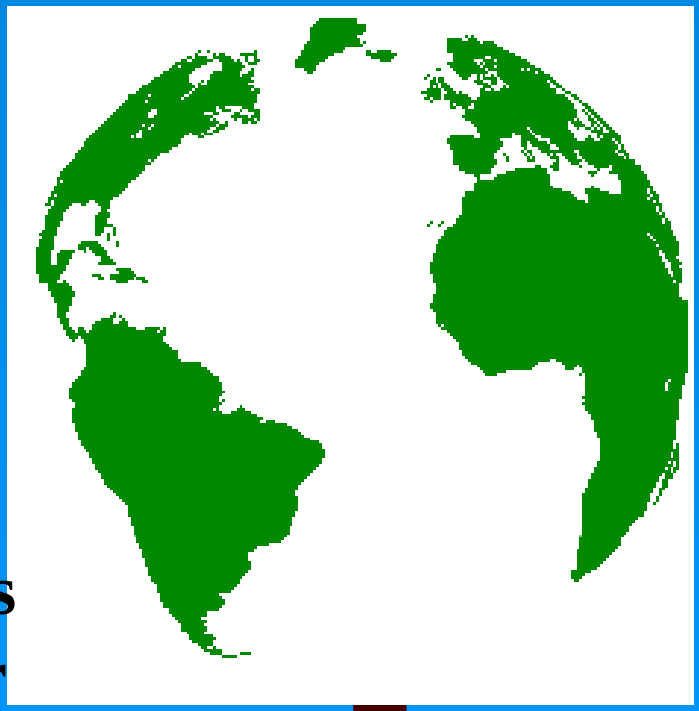
*Framework for Integrated Assessment and Valuation of Ecosystem Functions, Goods and Services**



*Adapted from DeGroot, Wilson and Boumans 2002 "A typology for the description, classification, and valuation of ecosystem functions, goods and services" *Ecological Economics 41(3)* pp. 393-420.

ECOSYSTEM FUNCTION	ECOSYSTEM SERVICE (Examples)
REGULATING	**Disturbance Moderation** •Regulation of surface runoff and discharge to nearby streams and the Merrimack river •Flood control services provided by redeveloped wetlands and dams in nearby ponds
	Freshwater Regulation •Improved groundwater recharge capacity •Improved surface water quality through mitigating runoff from the site into nearby streams
	Waste Treatment •Pollution control and detoxification capacity restored on site and at off-site wetlands
	Wildlife Habitat •Feeding and breeding ground for identified freshwater fish species •Habitat for migratory waterfowl
SUPPORTING	**Nutrient Regulation** •Improved nutrient filtration capacity of off-site freshwater wetlands and stream buffers •Improved trapping of sediments and pollutants on-site.
CULTURAL	**Recreation and Amenity** •Improvement of aesthetics and associated re-sale values for nearby residential properties and commercial developments •Improvement of greenspace recreation opportunities through off-site wetland revegetation and stream remediation

Why Use *Ecosystem Services* as the cornerstone of the EcoValue Project?



Advantages:

- ❑ **Brings together ecological and economic concepts in a dynamic conceptual system**
- ❑ **Makes use of best-available economic tools and methods to reveal meaningful values for non-marketed environmental systems**
- ❑ **Can be used to by decision makers to evaluate tradeoffs between land use change and human values.**

Valuation Techniques used in the EcoValue Project

•**Avoided Cost** (AC): services allow society to avoid costs that would have been incurred in the absence of those services; flood control (barrier islands) avoids property damages, and waste treatment by wetlands avoids incurred health costs.

•**Marginal Product Estimation** (MP): Service demand is generated in a dynamic modeling environment using production function (i.e., Cobb-Douglas) to estimate value of output in response to corresponding material input.

•**Factor Income** (FI): services provide for the enhancement of incomes; water quality improvements increase commercial fisheries harvest and thus, incomes of fishermen.

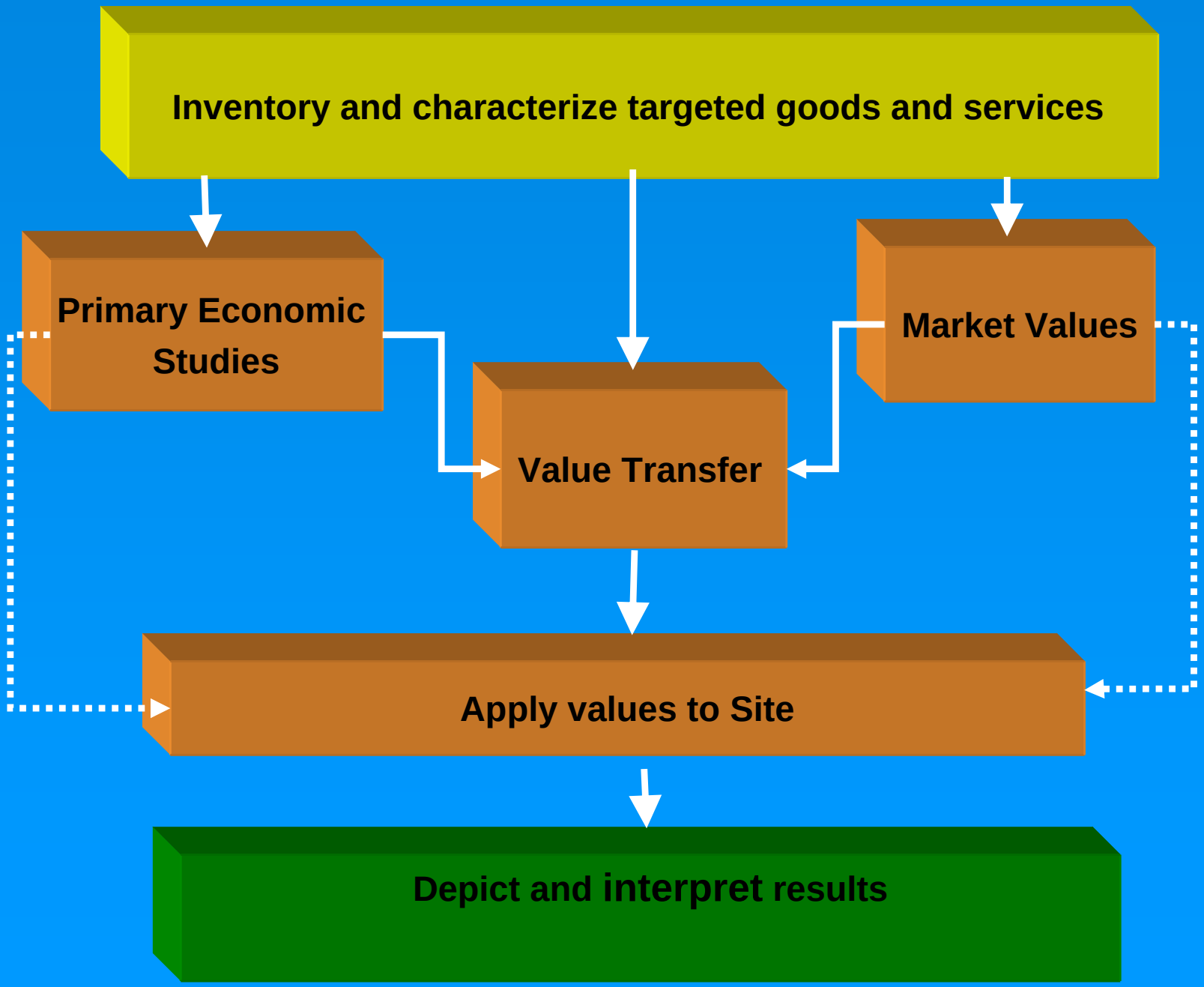
•**Travel Cost** (TC): service demand may require travel, whose costs can reflect the implied value of the service; recreation areas attract distant visitors whose value placed on that area must be at least what they were willing to pay to travel to it.

• **Hedonic Pricing** (HP): service demand may be reflected in the prices people will pay for associated goods: For example, housing prices along the shore of pristine freshwater lakes tend to exceed the prices of inland homes.

•**Contingent Valuation** (CV): service demand may be elicited by posing hypothetical scenarios that involve some valuation of alternatives; people would be willing to pay for increased water quality in freshwater lakes and streams.

•**Group Valuation** (GV): This approach is based on principles of deliberative democracy and the assumption that public decision making should result, not from the aggregation of separately measured individual preferences, but from *open public debate.*

Spatially Explicit Value Transfer



The Valuation Database: Study Selection, Data Entry and Aggregation

Transfer Study Selection

Current Decision rules for selecting empirical studies:

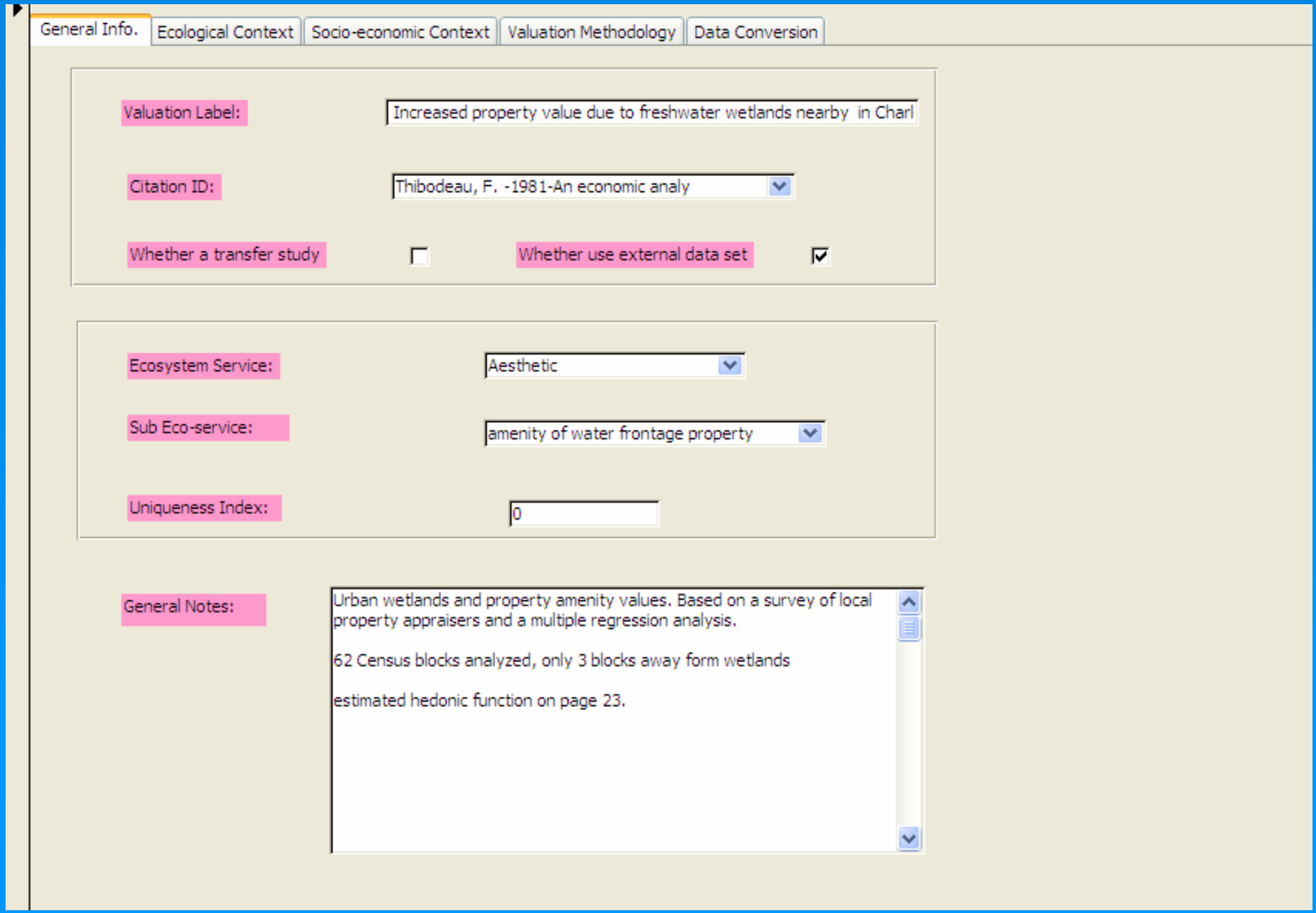
- **Published in peer-reviewed journals or books**
- **Limited to results that can readily be translated into spatial equivalencies—(i.e., per ha; per acre)**
- **Focused on regions in North America, Europe, New Zealand and Australia**
- **Focused primarily on non-consumptive resource use and ecosystem services**

Valuation Literature: EcoValue© and EVRI™

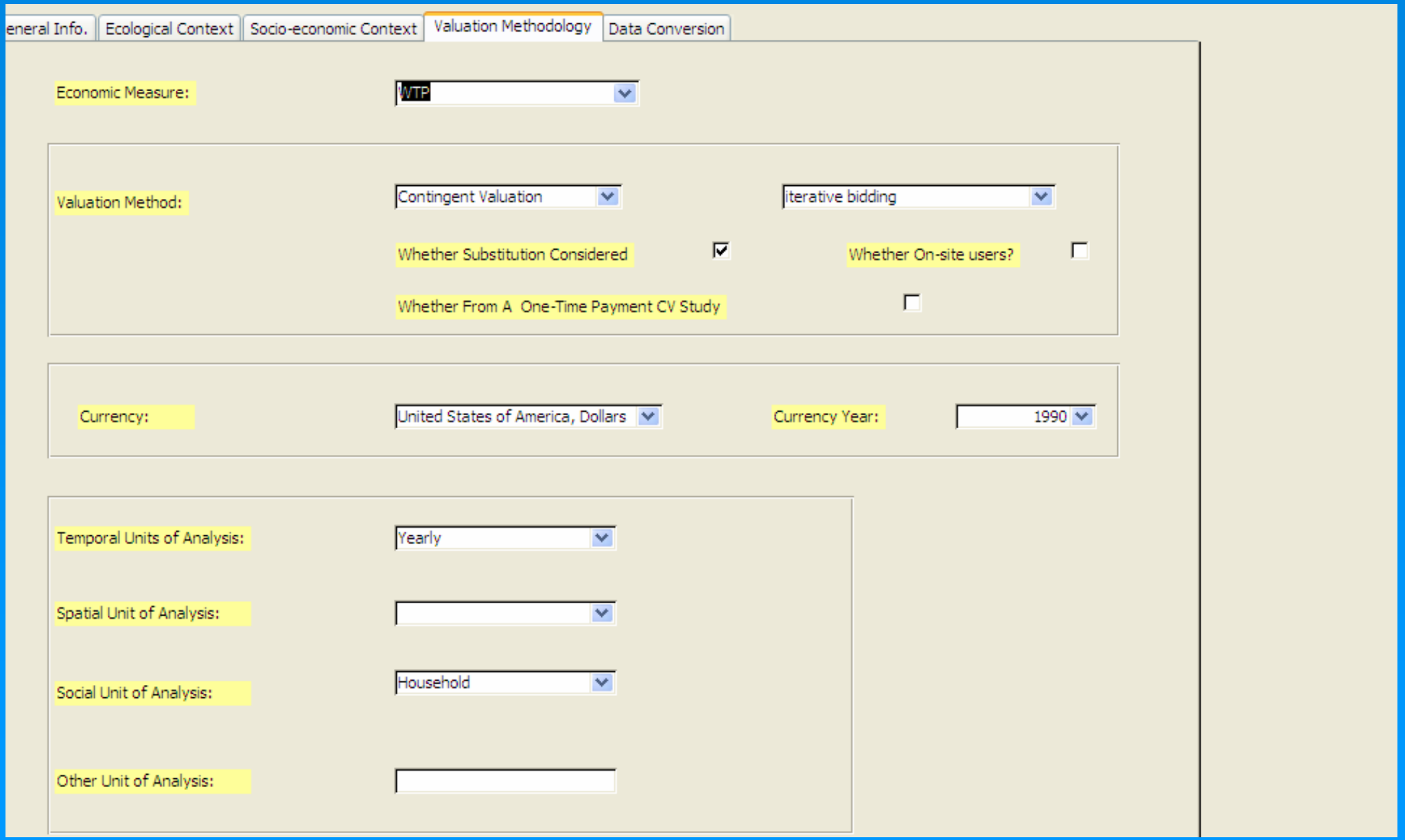
Current Status	EVRI	EVP
Total Number of studies in English	1290	701
Number of built environment studies	92	0
Nmber of human health studies	268	0
Number of strictly ecological studies	0	165
Percent Ecosystem service valuation studies*	62%	100%
Percent North American studies	68%	>90%

***# of ecological function studies + # of non-extractive use studies + # of passive use studies/total # of studies in English**

Sample Data Entry Form: General



Sample Data Entry Form: Valuation



Sample Data Entry Form: Conversion Notes

General Info. | Ecological Context | Socio-economic Context | Valuation Methodology | Data Conversion

Oringinal Value_Lower Bound:	$368,313.00
Oringinal Value_Upper Bound:	$5,560,975.00
Oringinal Value_Mean:	
Oringinal Value_Median:	

2001 Value_Lower Bound:	$3.36
2001 Value Upper Bound:	$50.75
2001 Value_Mean:	
Average Value:	$27.06
Whether processed data	☐

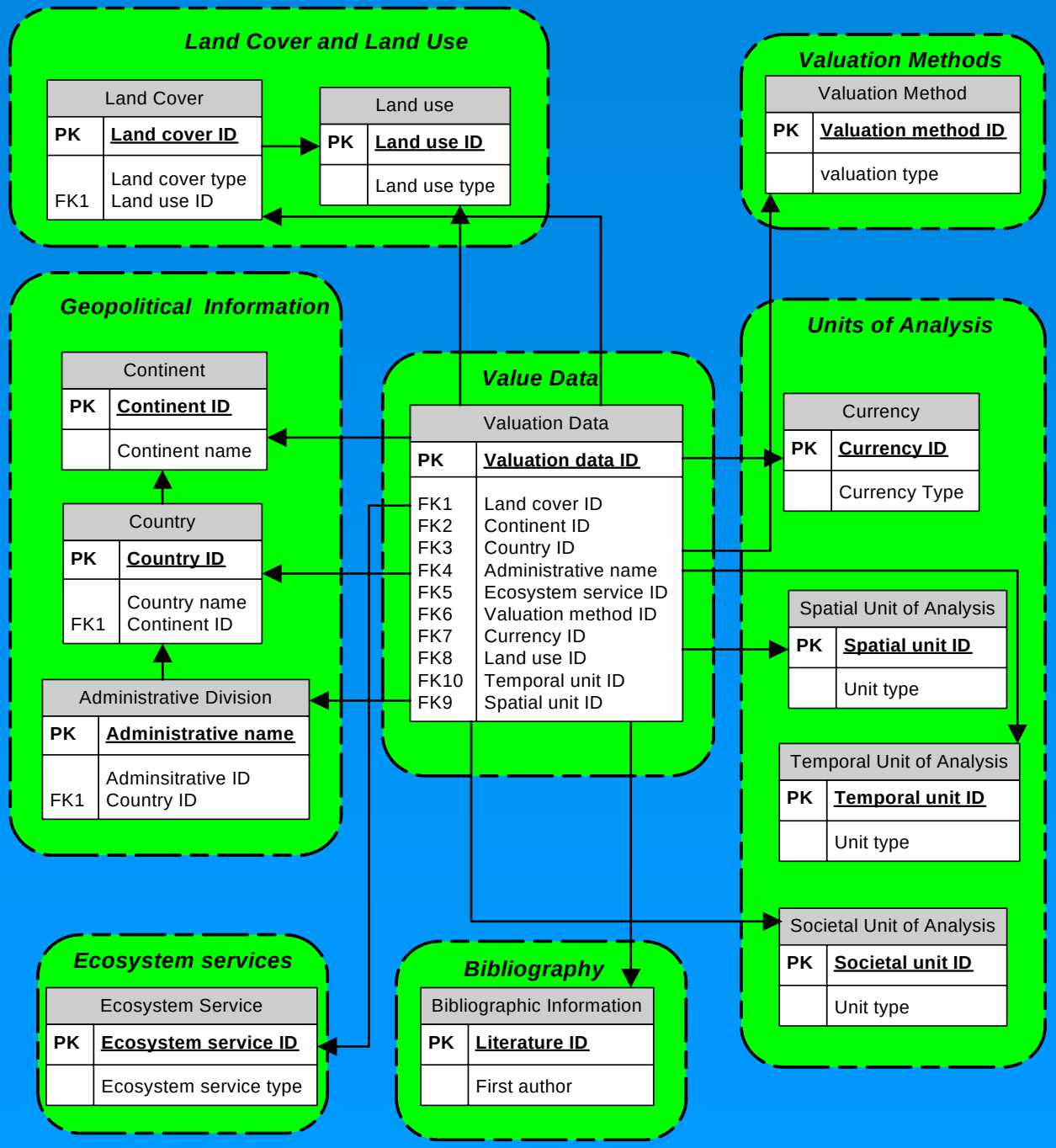
Converstion Notes:

1. the total water area in Indiana statewide was used (550 square miles).

Source: http://www.50states.com/indiana.htm

2. the currency year wasn't reported in the study. The publication year is used.

Sample GeoDatabase Links

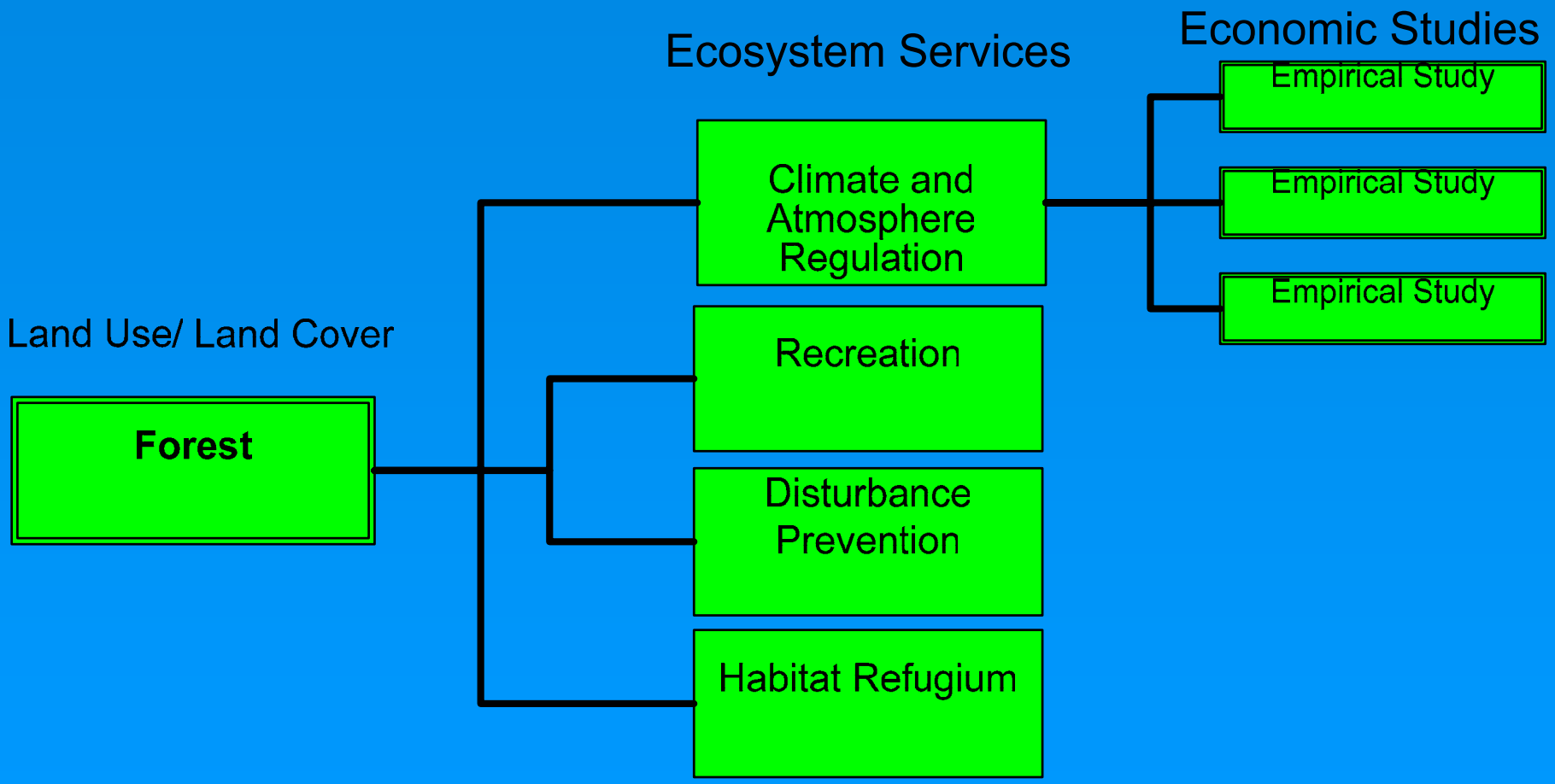


Sample EcoValue Project© Land Use/Cover Codes and Corresponding USGS National Land Cover Data (NLCD) Codes

EVP Codes	EVP Description	NLCD Codes	NLCD Description
1	cropland	82,83,84	row crops, small grain, fallow
2	pasture	81	pasture
3	forest	41,42,43	deciduous .,evergreen,mixed forests
4	barren land	31(part),32,33	bare rock/sand,quarries,transitional
5	urban greenspace	85	urban/recreation. greenspace
6	woody perennial	61	orchards
7	beaches	31(part)	rock/sand
8	high impact-human	22,23	high-density residential,commercial
9	low/med impact human	21	low-density residential
10	wetland-fresh	91(part), 92(part)	wetland
11	wetland-salt	91(part), 92(part)	wetland
12	freshwater	11(part)	water
13	saltwater	11(part)	water
51	shrubland	51	shrubland

USGS DATA: http://landcover.usgs.gov/natllandcover.asp

One-to-Many Relationships Between Land Cover, Ecosystem Services and Economic Values



Spatial Aggregation

Value of Ecosystem Services ($ ha^{-1} per year)**:**

$$V(ES_k) = \sum_{i=1}^{n} A(LU_i) \times V(ES_{ki})$$

Where A(LUi) = Area of i^{ln} (Land Use in hectares)
and $V(ES_{ki})$ = Annual value of k^{ln} ES (Ecosystem Services) for each i^{ln} LU (in $/ha/yr).

Spatial Boundary Units Tried Thus Far:

Biogeophysical

- Watersheds and Tributaries (Huc 6, Huc 8, Huc 12)
- Ecoregions

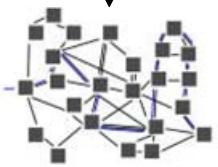
Socioeconomic

- State
- County
- Individual Property Parcels

Putting it All Together

Literature review and collection

Process and Input Valuation Data



Relational Microsoft Access® database

Integrate Valuation Data with GIS

Active Server Pages (ASP).

Delivery of the ecosystem services value via internet

ESRI® ArcIMS

The EcoValue WebSite©

http://ecovalue.uvm.edu

Welcome Page

the Gund Institute for ecological economics

The University of Vermont

The EcoValue Project

Welcome to the EcoValue Project!

Based at the University of Vermont, the EcoValue project provides an interactive decision support system for assessing and reporting the economic value of ecosystem goods and services in geographic context.

The project combines Geographic Information Systems (GIS) and relational database technology to provide interactive maps, graphs and statistics that are dynamically generated by linking together the best available peer-reviewed valuation literature and GIS land cover layers in a flexible web-based platform.

Three principles guide the EcoValue project:

1. Use the best available economic methods and data sources to develop a standard methodology for assessing ecosystem goods and services in spatially explicit context.
2. Create a web-based interface that allows multiple stakeholders to conduct value assessments of selected landscape features in a fully 'data transparent' mapping environment.
3. Design and calibrate a transparent value-transfer algorithm that will provide end-users with the ability to estimate economic values in a spatially explicit landscape context without incurring the high cost that would be needed to conduct a series of direct empirical valuation studies.

The end result you find here is a web-based, GIS assessment tool capable of generating meaningful and reliable economic value estimates of landscape based ecosystem goods and services that can then be integrated into research, decision-making and planning.

The EcoValue project has been funded through competitive grants to provide valuation estimates for the State of Maryland and the Northern Forest region , but our vision is to extend this analysis to other regions throughout United States and the world. For more information, please contact Dr. Matthew A. Wilson at the University of Vermont.

View a PowerPoint Presentation of the EcoValue Project

Contact Info

Dr. Matthew Wilson

School of Business Administration and the Gund Institute for Ecological Economics

The Northern Forest Module

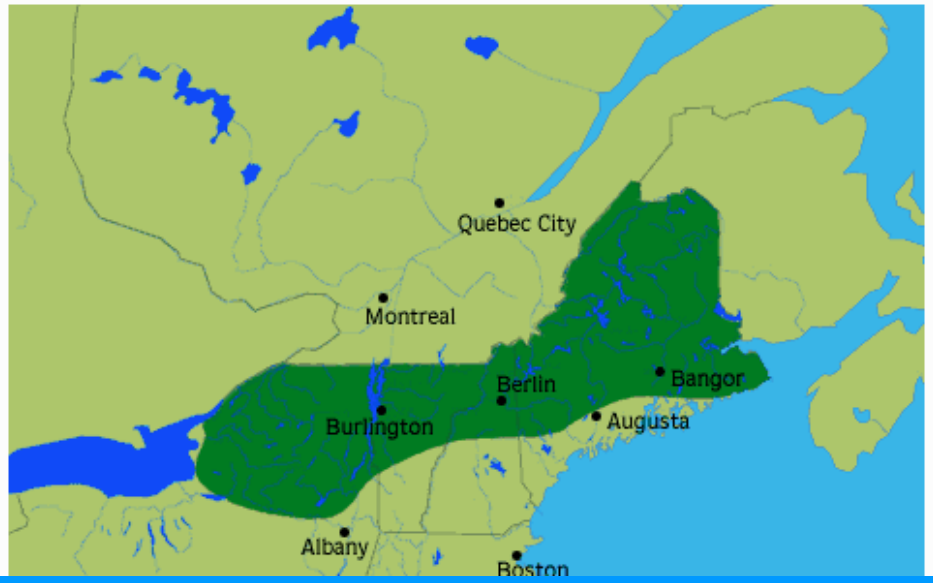
The Northern Forest Map Viewer

This module of the EcoValue project was developed with support from the Northeastern States Research Cooperative and is intended to provide a web-accessible, GIS ecosystem valuation tool for citizens and decision makers in the northeastern States of New Hampshire, New York, Maine, and Vermont.

The ecological goods and services provided by natural systems within the northern forests are critical to the healthy functioning of the natural environment; but importantly, they also contribute significantly to human welfare, both directly and indirectly, and thus represent a significant portion of the total social and economic value of the natural landscape. When ecosystem service values are not fully accounted for, they remain outside of forest land use planning, potentially compromising the long-term sustainability of ecologically significant landscapes.

The interactive decision-support module, NF Map Viewer, is designed to provide the best available maps, graphs and figures that explain the economic value of ecosystem goods and services to researchers, decision-makers, and public stakeholders throughout the Northern Forest region. Because of its open-access design, results will cut across, and provide critical support for, several research themes listed under the Northeastern States Research Cooperative: Forest Watershed planning, Ecological and economic implications of rural-suburban transition, Conflict resolution in the N. Forest, and Shared databases.

The principal mapping unit of analysis is the watershed. Results of all queries using the Map Viewer are downloadable in both spreadsheet and graphic interchange formats so that the information can be readily used.



The EcoValue Project

Maryland EcoValue Module

Northern Forest EcoValue Module

Information

NF Map Viewer

NF EVP Proposal

Land Cover/Services Crosswalk Table

Land Use / Land Cover Definitions

Ecosystem Services Definitions

NF EVP References

NF Natural Resources Links

Download GIS Data

Contact Info

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Northern Forest ArcIMS Map Viewer

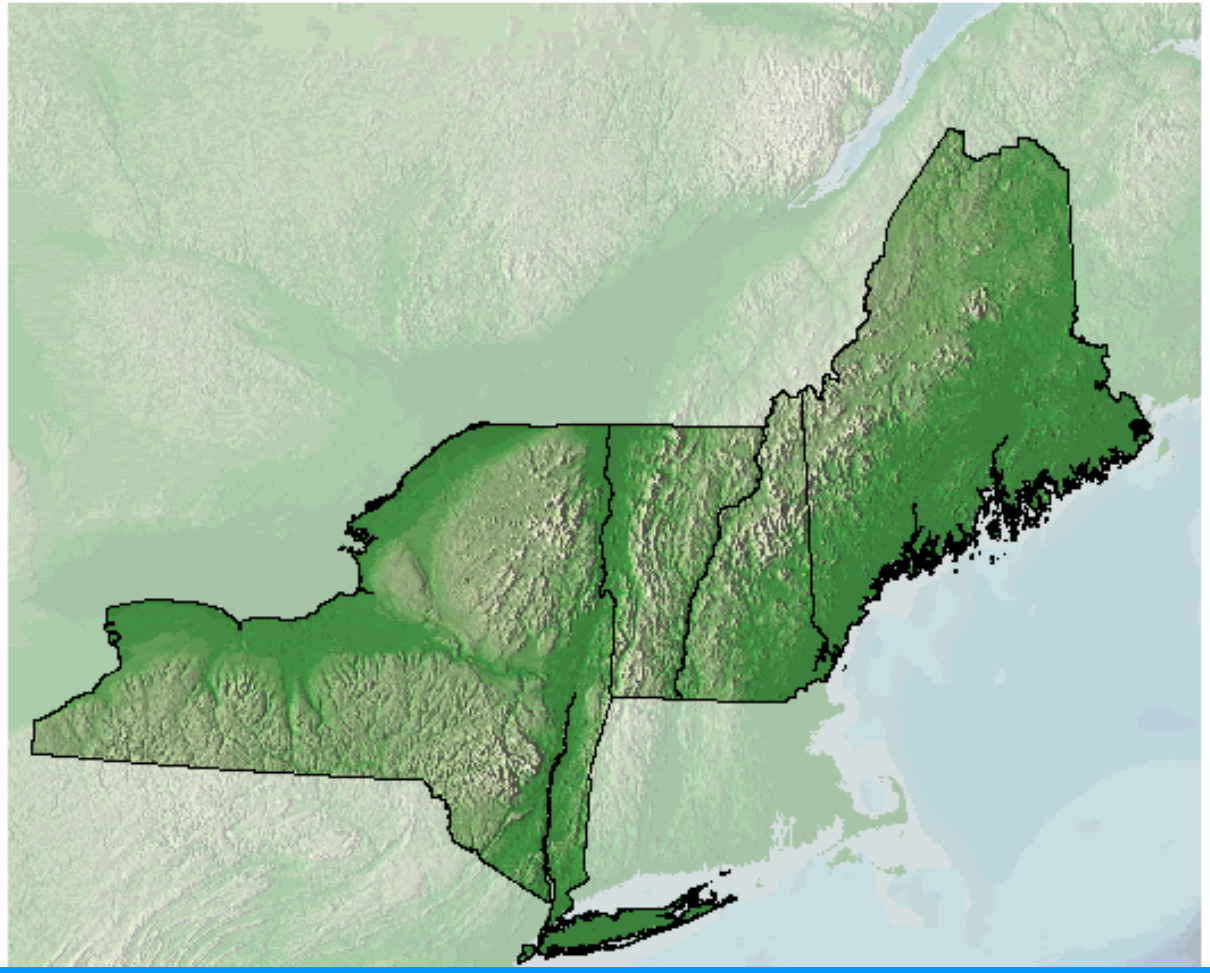
the Gund Institute for ecological economics

The University of Vermont

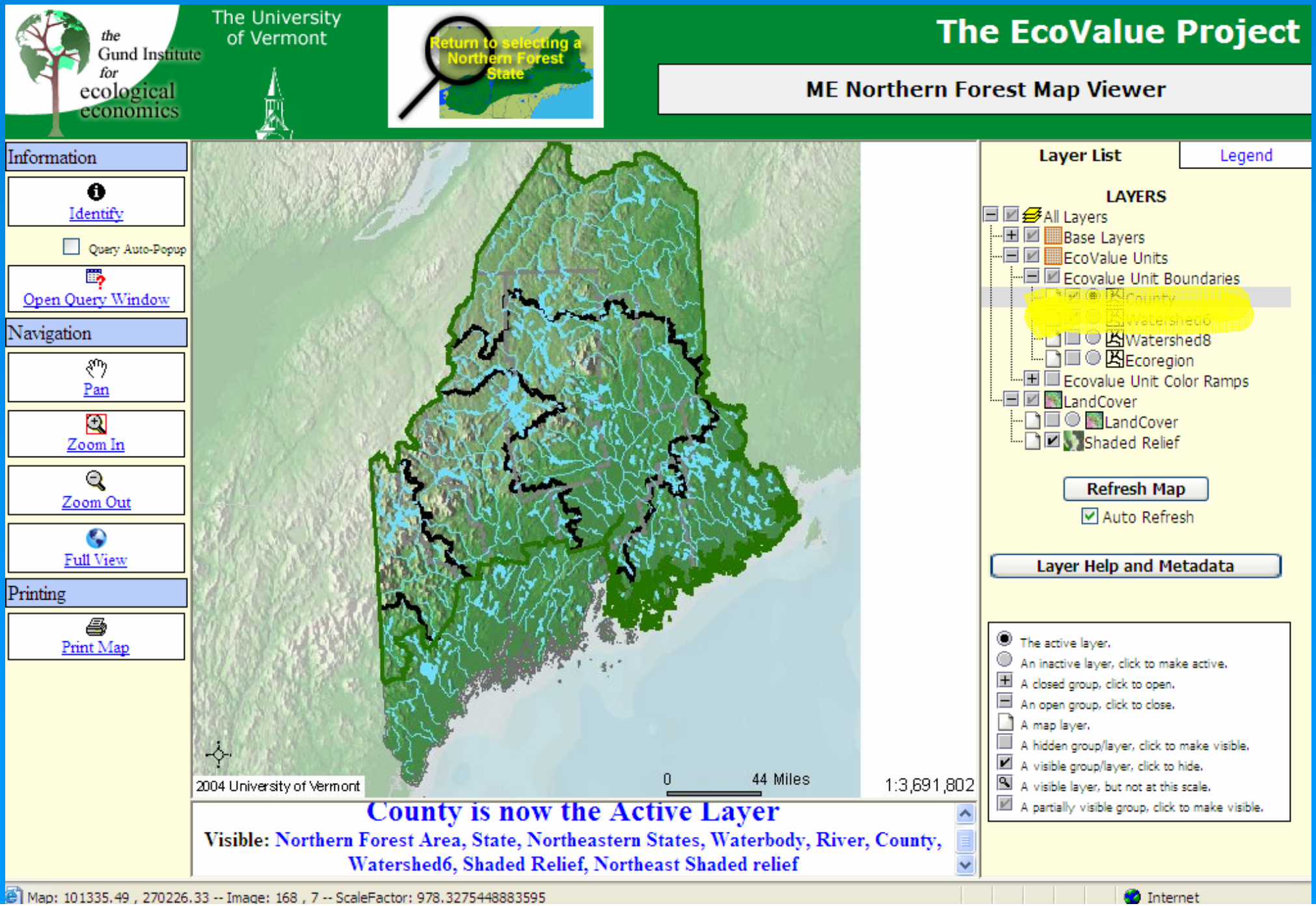
The EcoValue Project

Select a Northern Forest State

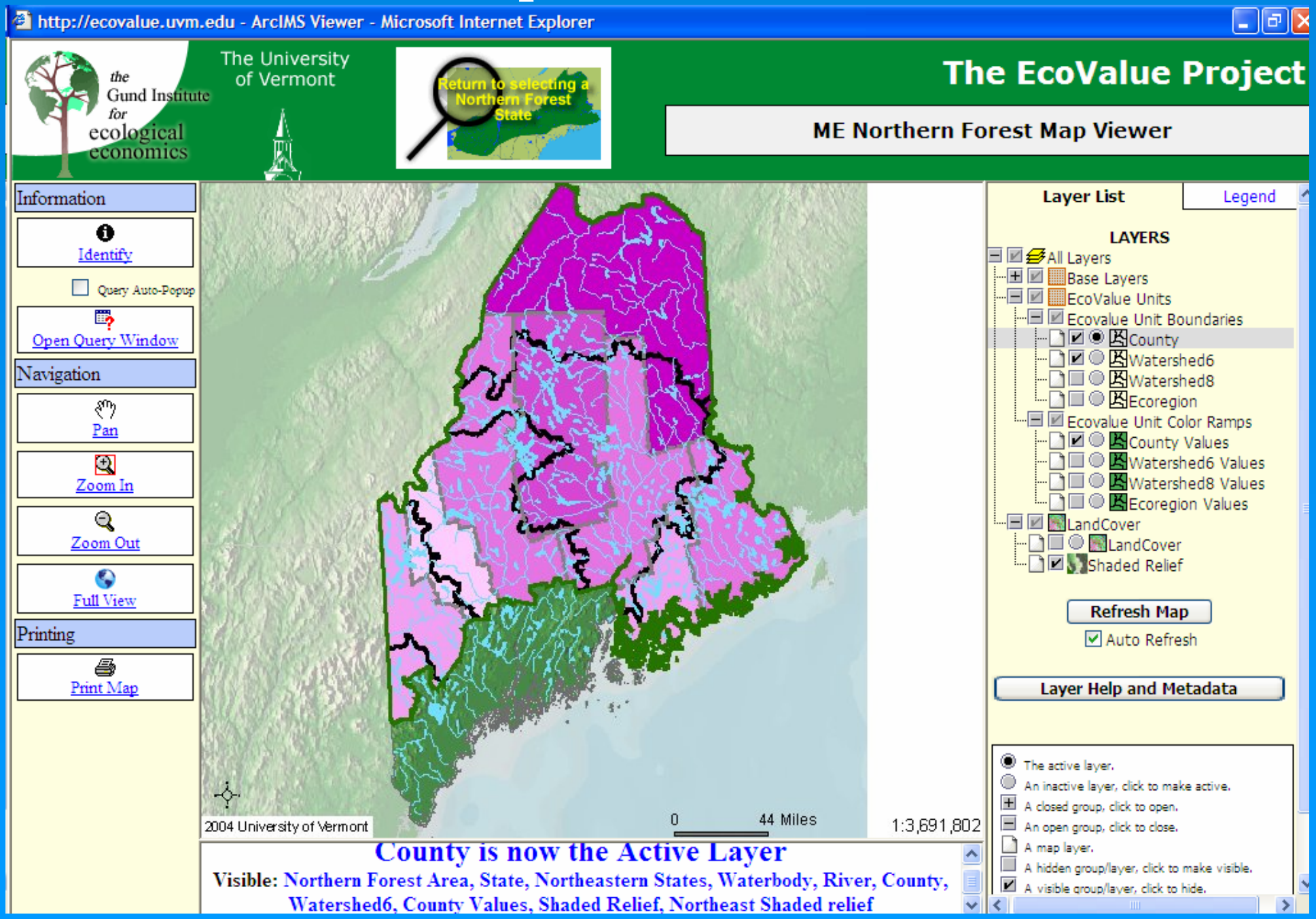
The Northern Forest Map Viewer is divided into state sub-modules. Please click on a state to view.



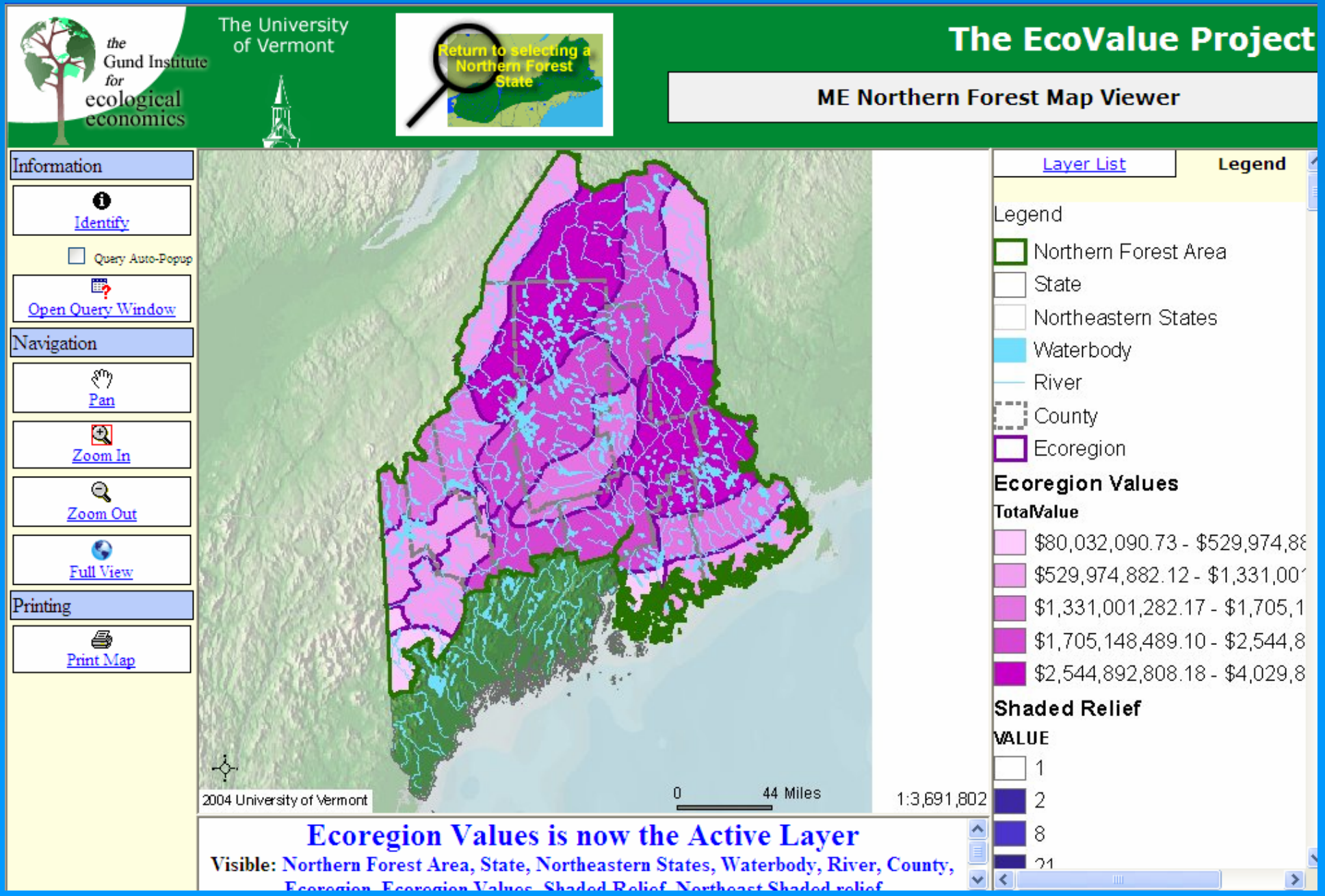
Northern Forest ArcIMS Map Viewer: County and 6-Digit Watershed Active



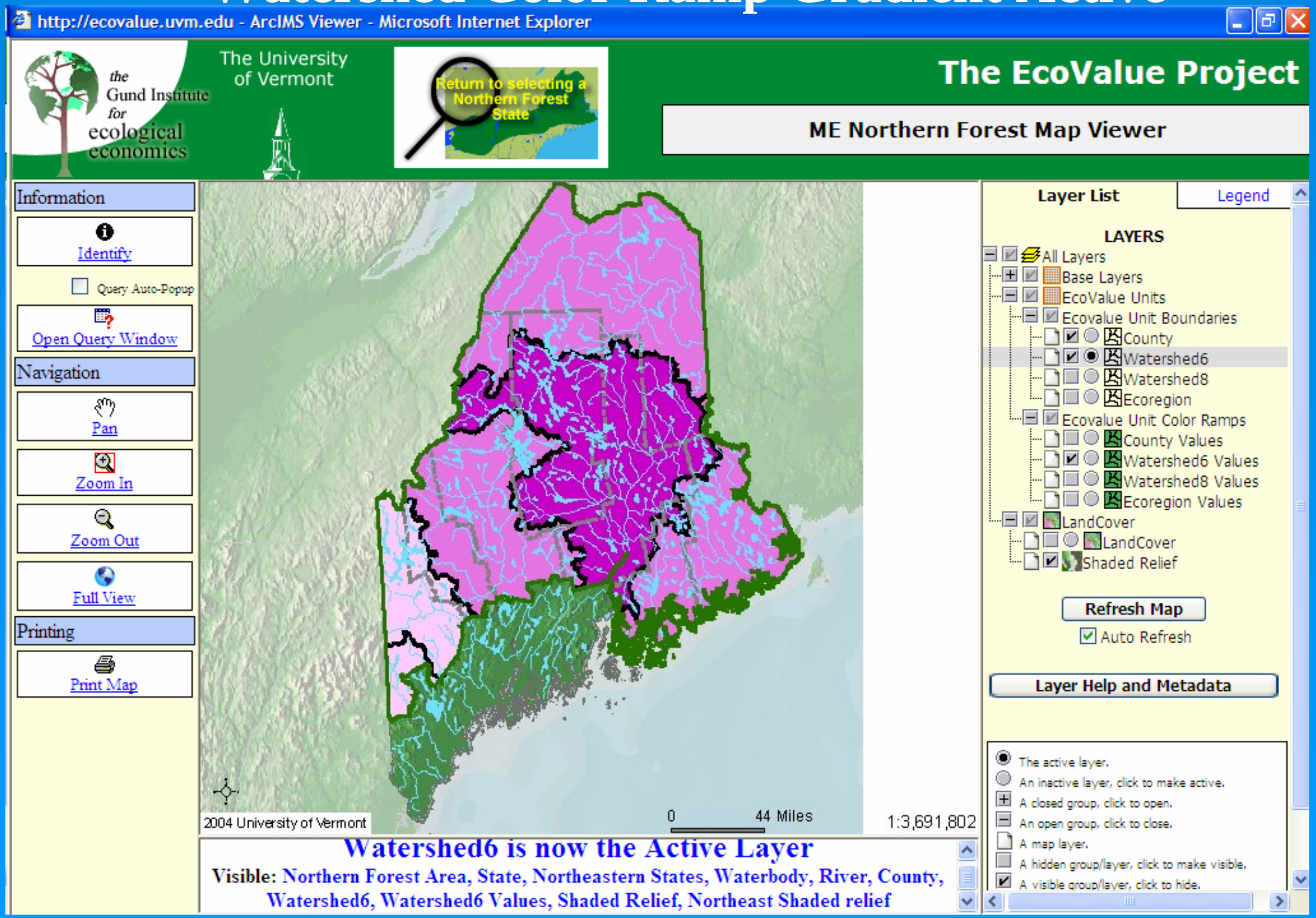
Northern Forest ArcIMS Map Viewer: County Color Ramp Gradient Active



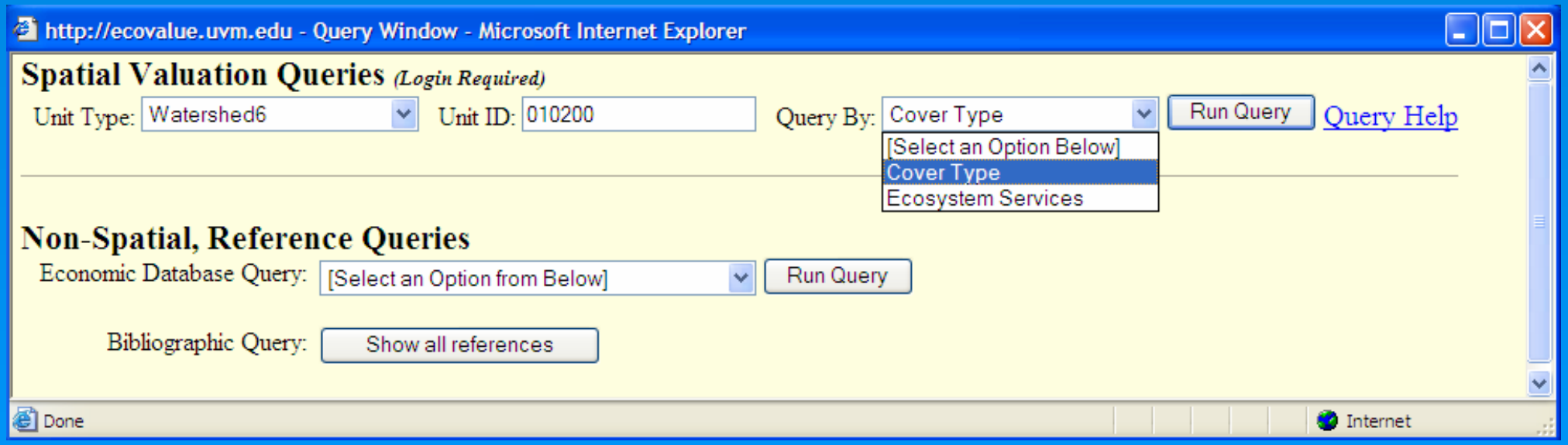
Northern Forest ArcIMS Map Viewer: Ecoregion Color Ramp Gradient Active



Northern Forest ArcIMS Map Viewer: 6-Digit Watershed Color Ramp Gradient Active



The Query Window



Spatial Query: by Cover Type

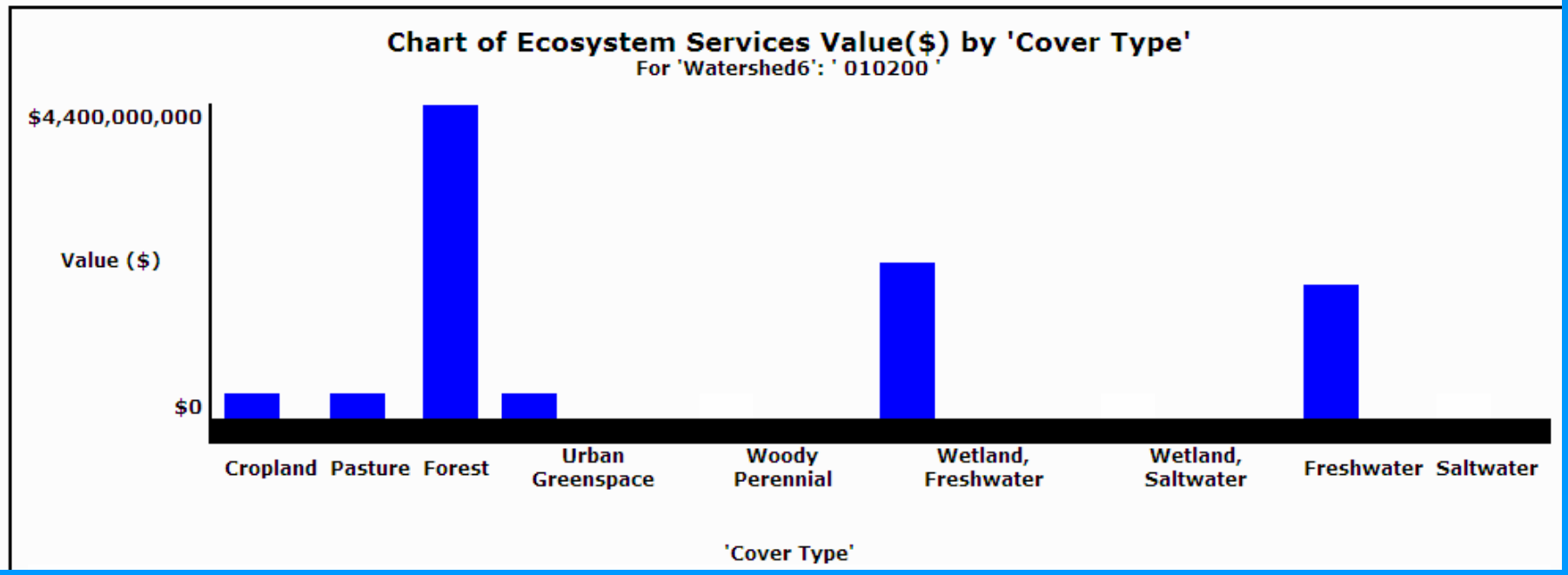
Query Results for Penobscot Watershed (Land Cover)

Close Window

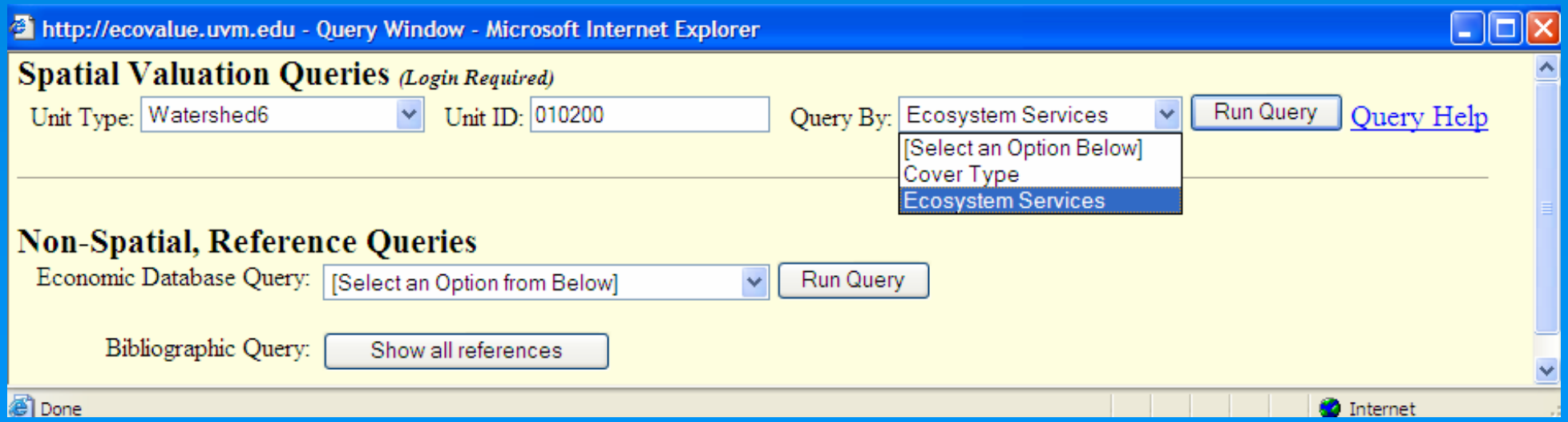
Query: Total Value by Land Cover for Watershed6: 010200

CoverID	CoverName	Area(Ha)	Mean Value($)	Min Value($)	Max Value($)
1	Cropland	34,987	123,668,421	123,668,421	123,668,421
2	Pasture	6,929	24,397,356	24,397,356	24,397,356
3	Forest	1,801,833	4,379,210,292	1,811,150,648	8,893,818,217
5	Urban Greenspace	4,487	24,556,968	215,999	48,897,827
6	Woody Perennial	66	8,105	8,105	8,105
10	Wetland, Freshwater	111,585	2,172,435,082	501,937,790	6,389,715,636
11	Wetland, Saltwater	14	386,758	366,610	422,337
12	Freshwater	129,123	1,860,613,679	445,855,293	6,361,931,474
13	Saltwater	154	2,225,887	533,385	7,610,896

Save Query to Excel File



The Query Window



Spatial Query: by Ecosystem Service

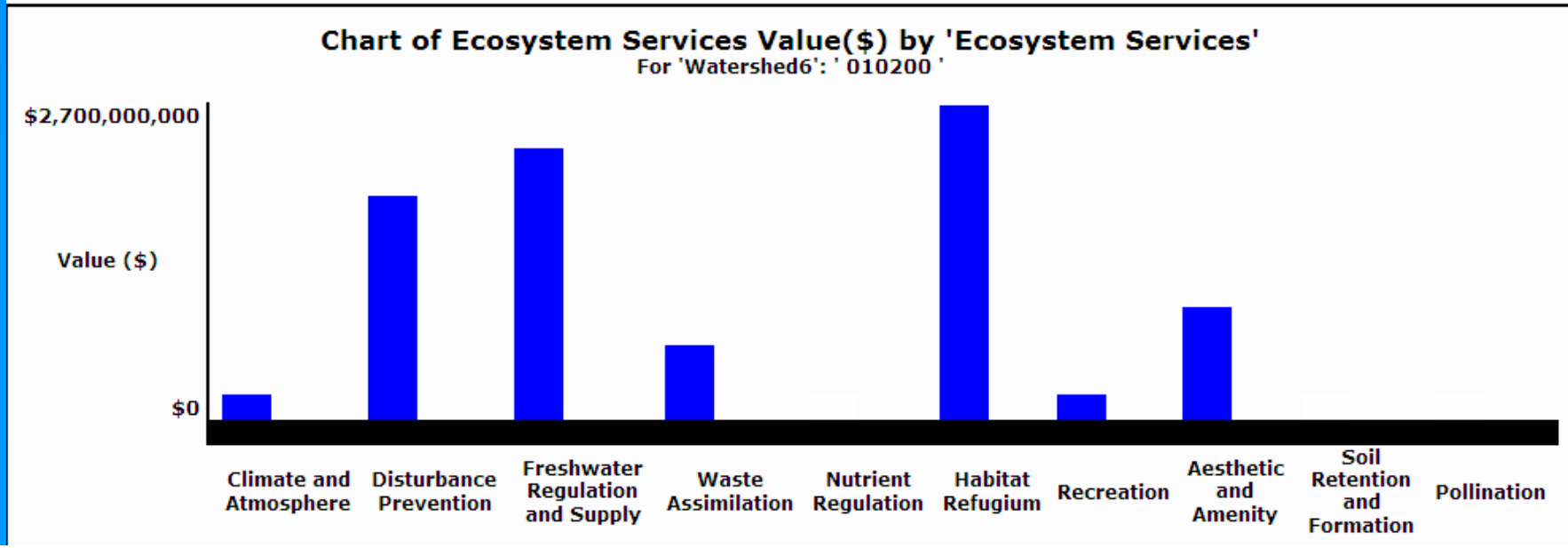
Query Results for Penobscot Watershed (Ecosystem Service)

Close Window

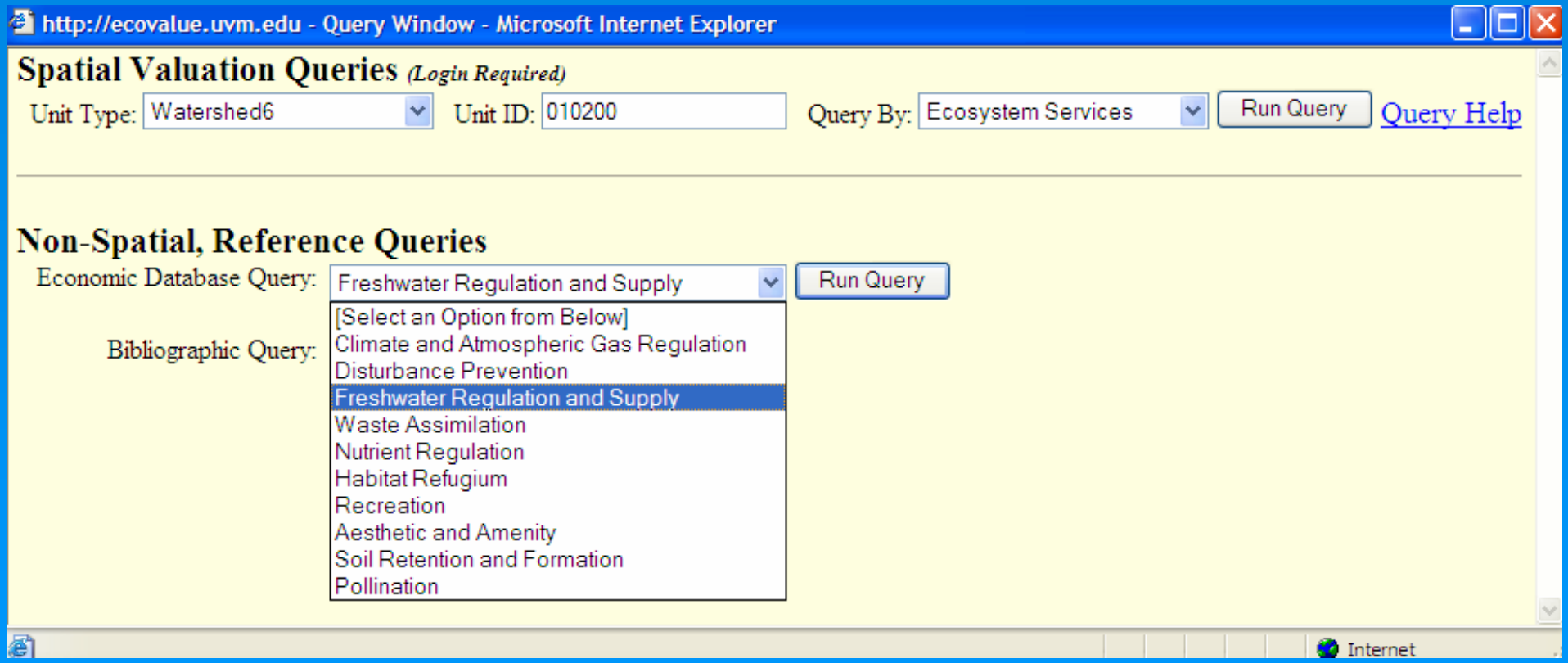
Query: Total Value by Ecosystem Service for Watershed6: 010200

Services ID	Services Name	Area (Ha)	Mean Value($)	Min Value($)	Max Value($)
1	Climate and Atmosphere	1,801,833	29,385,909	2,849,598	55,966,724
2	Disturbance Prevention	1,913,432	1,901,152,114	1,901,152,114	1,901,152,114
3	Freshwater Regulation and Supply	240,863	2,309,896,676	10,588,328	10,106,585,146
4	Waste Assimilation	116,073	631,315,176	5,541,378	1,257,086,117
5	Nutrient Regulation	14	352,274	352,274	352,274
6	Habitat Refugium	1,931,125	2,678,273,595	18,562,745	7,424,161,253
7	Recreation	2,047,198	68,849,095	809,462	136,888,933
8	Aesthetic and Amenity	282,779	961,158,830	961,158,830	961,158,830
9	Soil Retention and Formation	146,573	1,992,024	1,992,024	1,992,024
10	Pollination	41,982	5,126,855	5,126,855	5,126,855

Save Query to Excel File



Non-Spatial Reference Query

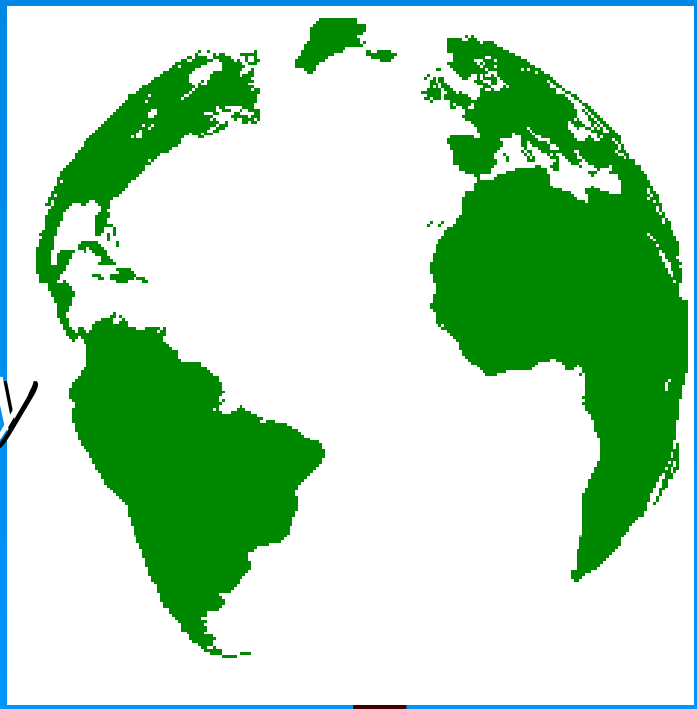


Non-Spatial, Query Results for Freshwater Regulation and Supply (incomplete list)

Author(s)	Year	Title	Label
Bouwes, N. W. and Scheider, R.	1979	Procedures in estimating benefits of water quality change	Aggregate value of water quality change in Pike Lake, Wisconsin
d'Arge, R.	1989	Okoboji experiment:comparing non-market valuation techniques in an unusually well-defined market for water quality	Willingness-to-pay for better water quality of West Okioboji lake compared to East Okioboji lake, Iowa
Desvousages, W. H., Smith, V. K. and Fisher, A.	1987	Option price estimates for water quality improvements: a contingent valuation study for the Monongahele River	Estimated option price from direct-question-method for changes in water quality of the Monongahela River, Montana
Desvousages, W. H., Smith, V. K. and Fisher, A.	1987	Option price estimates for water quality improvements: a contingent valuation study for the Monongahele River	Estimated option price from interative-bidding-method for changes in water quality of the Monongahela River, Montana
Goffe, L.	1995	The benefits of improvements in coastal water quality: a contingent approach	Willingness-to-pay per household for the ecosystem preservation against eutrophication at Brest Natural Harbour, France
Lant, C. L. and Tobin, G.	1989	The economic value of reparian corridors in cornbelt floodplains: a research framework	Estimated value of reparian wetlands necessary to raise the quality of the Edwards River to the level of the South Skunk River
Lant, C. L. and Tobin, G.	1989	The economic value of reparian corridors in cornbelt floodplains: a research framework	Estimated value of riparian wetlands necessary to raise the quality of the South Skunk river to the level of the Wapsipinicon river
Pate, J. and Loomis, J.	1997	The effect of distance on willingness to pay values: A case study of wetlands and salmon in California	Aggregate wliingness-to-pay for wetland improvement in the San Joaquin Valley, CA.
Ribaudo, M. and Epp, D. J.	1984	The importance of sample descrimination in using the travel cost method to estimate the benefits of improved water quality	Improved water quality value of St. Albans Bay, Vermont
Suherland, R. and Walsh, R. G.	1985	Effect of Distance on the preservation value of water quality	Aggregate willingness-to-pay to preserve water quality of the Flathead Lake and the lake area, Montana
Thibodeau, F. R. and Ostro, B. D.	1981	An economic analysis of wetland protection	Water supply service provided by the Charles River Basin, Massachusetts

Save Query to Excel File

Case Studies: Applying the Spatially Explicit Ecosystem Service Transfer Methodology in the "Real World"



School of Business Administration , University of Vermont

Practical Applications

In addition to advancing the scientific research agenda, the methodology is applicable in a wide-variety of Decision Making situations and can be used to clarify tradeoffs involved with:

- New Infrastructure Construction
- Resource Development
- Community Planning
- Remediation and Mitigation efforts
- Conservation Planning and Prioritization
- Sustainable Business Strategy and Growth Management

Applied Project: State of New Jersey

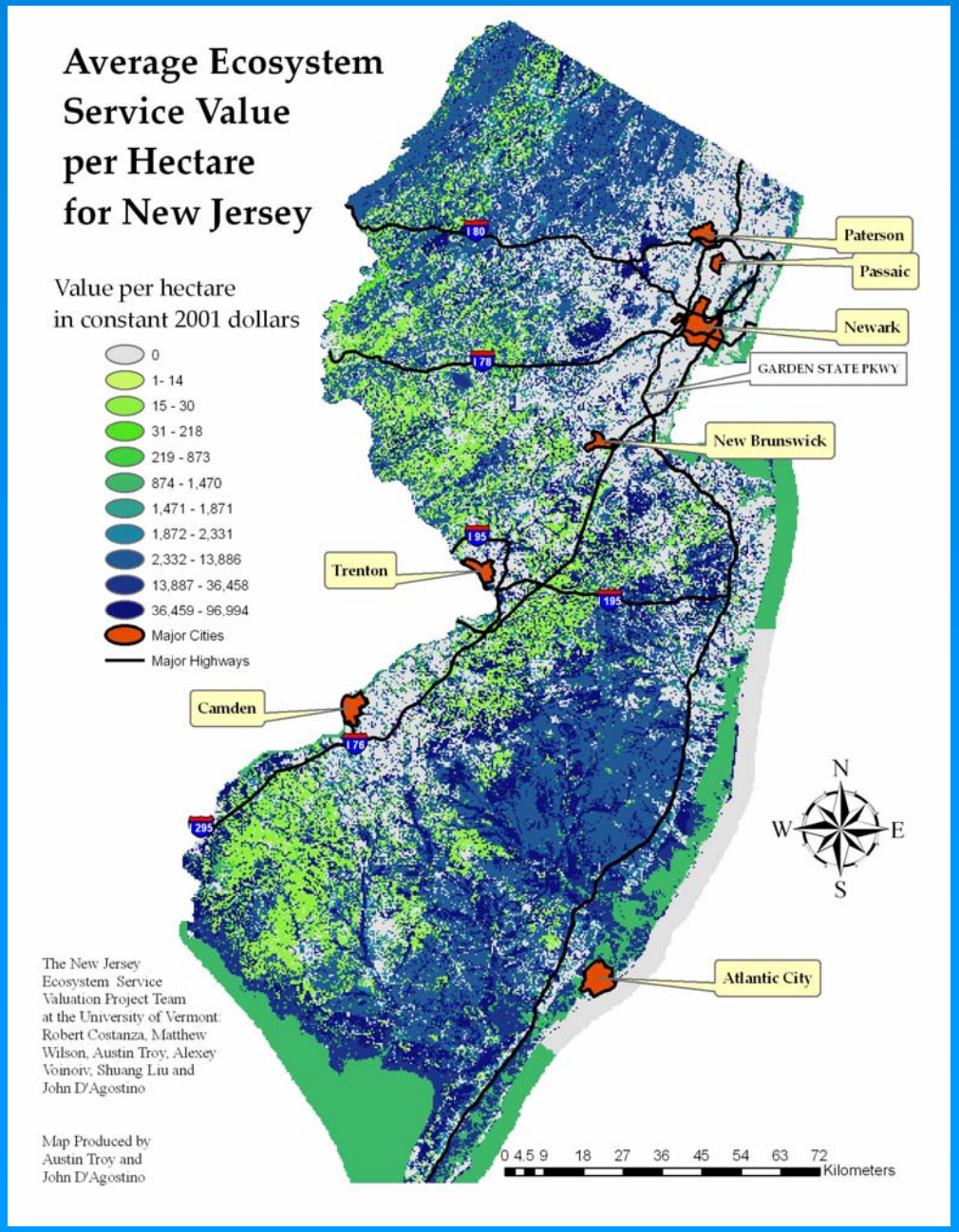
•In the Fall of 2004, the University of Vermont was awarded a one year contract to assist the State of New Jersey Department of Environmental Protection in the assessment of natural capital and ecosystem services

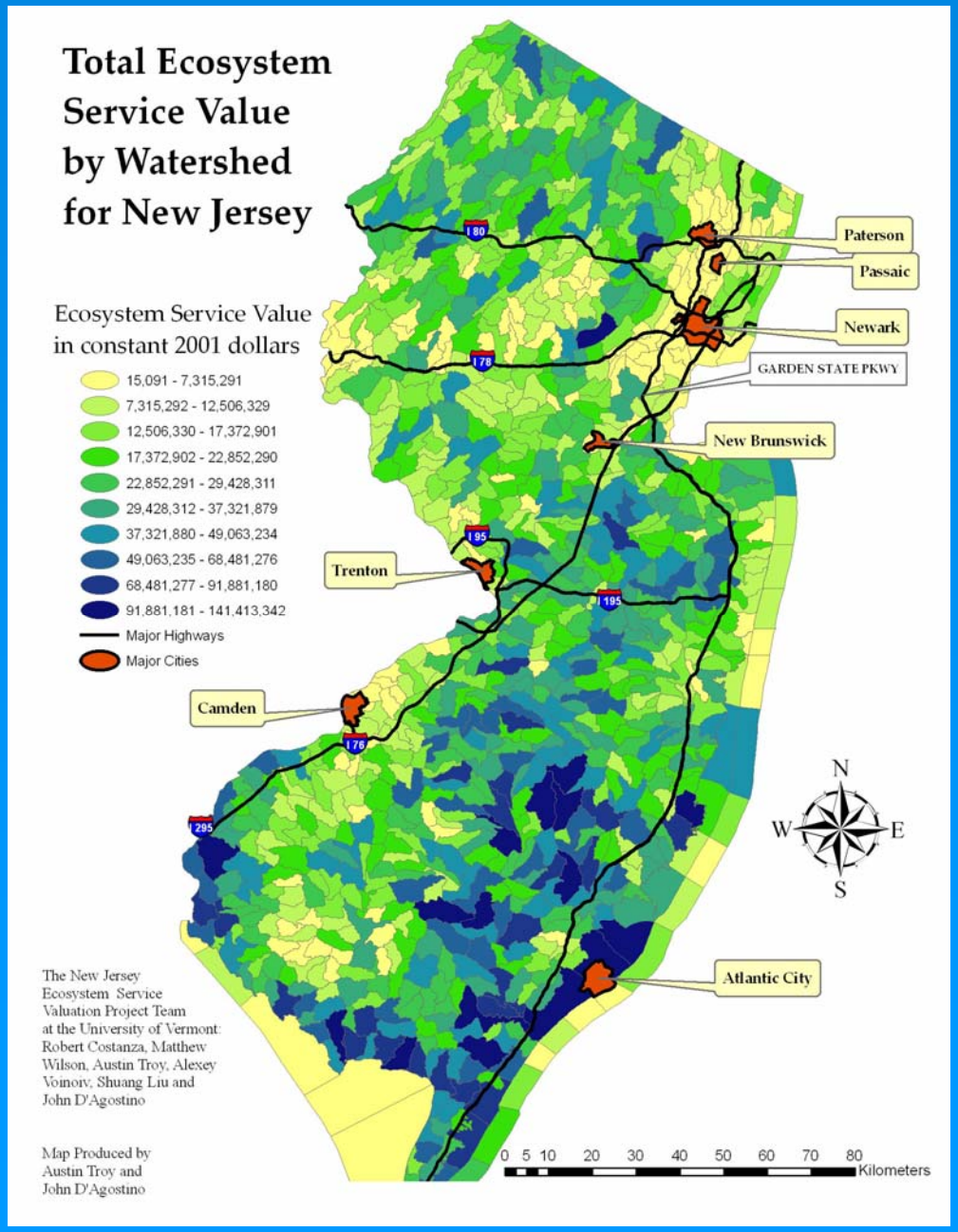
State of New Jersey

Among other things, the research team is using value transfer methods to prepare written estimates with supporting maps of the value of New Jersey's ecosystem services on a statewidebasis for the following types of natural assets:

- Agricultural land
- Forest land
- Rivers and streams
- Lakes and ponds
- Bays, estuaries, and other tidal waters
- Wetlands
- Beaches and dunes

Valuing New Jersey's Natural Capital and Ecosystem Services: Preliminary Findings





Applied Project: Massachusetts Commonwealth, MA.

- In 2003, Spatial Informatics Group, LLC. (www.sig-gis.com) used the NaturalAssets™ information system to help the Massachusetts Audubon Society to develop a baseline value Massachusetts' ecosystem services by sub-watershed as part of their "Losing Ground" report on the effects of continued urban development

CHAPTER 6

Accounting for the Economic Value of Ecosystem Services in Massachusetts

Thus far, we have laid out the costs of unchecked development in the Commonwealth in traditional conservation terms. Deforestation destroys wildlife habitat, fragmentation threatens biodiversity, and sprawling development affects quality of life. Protecting land is important for ecological as well as aesthetic and cultural reasons. As important as these factors are, however, most day-to-day land use decisions are based on market economics. Landowners are influenced by land prices as well as property tax assessments that value land based on its "fair market value." Similarly, local and state governments must often weigh the economic costs and benefits of infrastructure development while policy makers evaluate the tradeoffs between competing stakeholder demands in the marketplace.

The forests, rivers, wetlands, estuaries, and beaches throughout Massachusetts provide many different goods and services to the people of the Commonwealth. An ecosystem service, by definition, contains "the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life."[16] While these natural processes have been well understood from a scientific perspective for some time, only recently has there been an effort to quantify the economic value of these services.

Estimating the Value of Ecosystem Services in Massachusetts

For this chapter, Mass Audubon worked with Dr. Matthew A. Wilson and Dr. Austin Troy, professors associated with the Gund Institute for Ecological Economics at the University of Vermont, to create a spatially explicit economic model of ecosystem service values for the Massachusetts landscape.

Our primary interest is to shed light on the nonmarket economic benefits of ecosystem services associated with habitat and open land when it is left in its natural state, as opposed to direct or extractive uses such as forestry, fishing, and agriculture. To estimate the economic value of ecosystem services in Massachusetts, we relied on secondary analysis of published results drawn from the peer-reviewed economic literature. When analyzed carefully, information from studies published in the economic literature can form a meaningful basis for directing environmental policy and management.[17]

The forests, rivers, wetlands, estuaries, and beaches throughout Massachusetts provide many different goods and services to the people of the Commonwealth.

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Report: http://www.massaudubon.org/news/index.php?id=19&type=news#download

A Scoping Tool: Revealing Gaps in Value-Transfer Data

Figure 17

Ecosystem Services and Available Research

Simplified Land Use Category	Cropland	Pasture	Forest	Wetland-Fresh	Wetland-Salt	Open Land	Urban Green Space*	Woody Perennial	Water and Coastal Embayment	Water-based Recreation	Highly Impacted+
Climate Regulation	▲	▲	▲	▲	▲	▲	▲	▲			
Freshwater Regulation and Supply			▲	▲	▲	▲			▲		
Waste Assimilation and Water Quality			▲	▲	▲	▲	▲		▲		
Nutrient Regulation	▲	▲	▲	▲	▲	▲	▲	▲	▲		
Habitat Refugium	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	
Soil Retention and Formation	▲	▲	▲	▲	▲	▲	▲	▲			
Disturbance Prevention	▲	▲	▲	▲	▲	▲					
Pollination	▲	▲	▲	▲	▲	▲	▲	▲			
Recreation and Aesthetics	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	

Mapping of ecosystem services to Massachusetts land cover types.

▲ Service provided by land cover type, with sufficient peer-reviewed research for valuation in **MA**

▲ Service provided by land cover type, but insufficient peer-reviewed research for valuation in **MA**

* Includes urban open space and participation recreation

\+ Includes commercial, industrial, and residential development

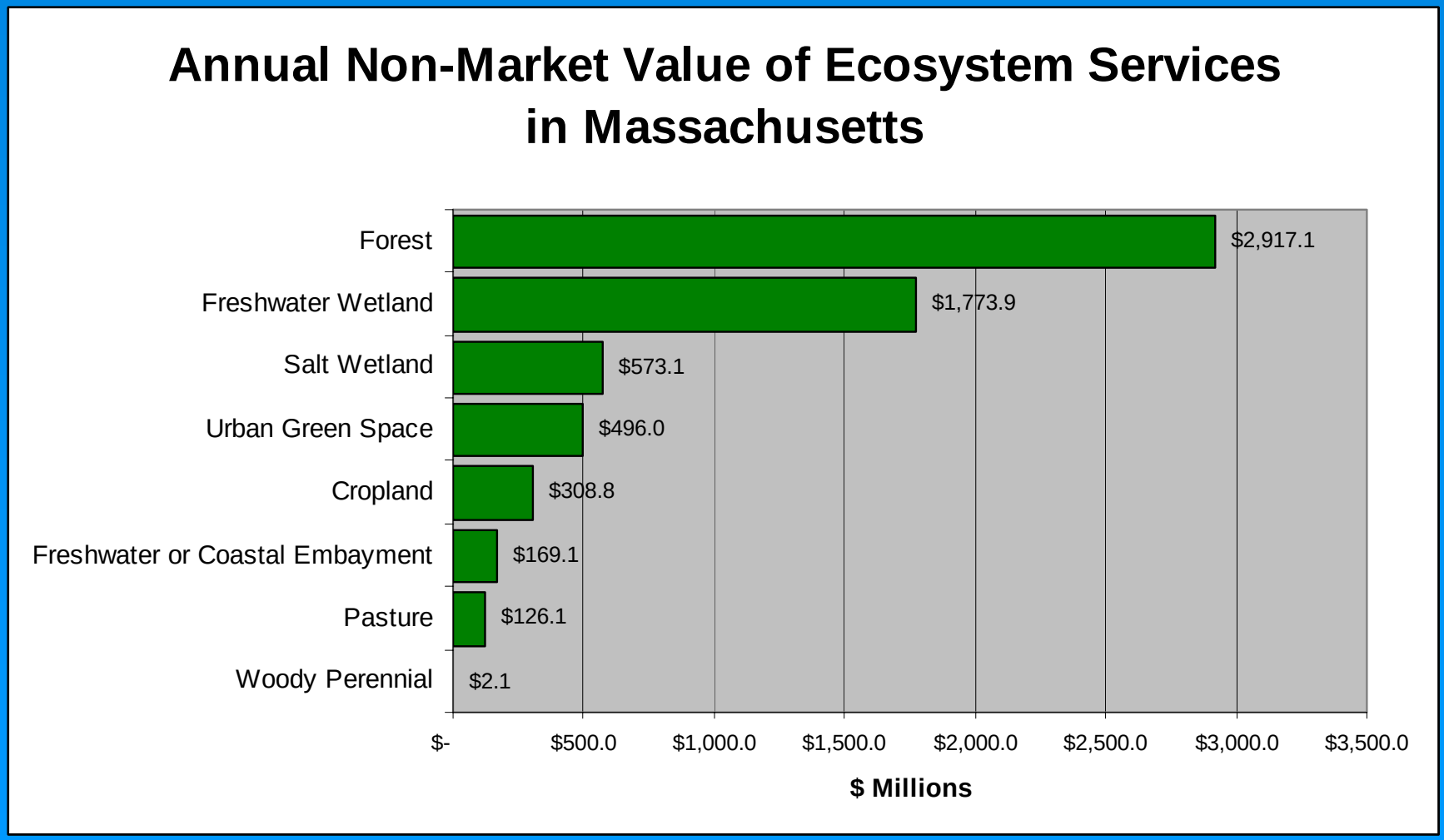
Aggregate Results : Massachusetts Commonwealth

Non-Market Ecosystem Service Value Estimates by Land Cover Type

Land Use Type	Ecosystem Services Used in Valuation	# Data Sources	Mean Total $acre/yr (2001 dollars)	Min value	Max value
Freshwater Wetland	Disturbance Prevention; Freshwater Regulation & Supply, Waste Assimilation, Aesthetic/Amenity, Soil Retention	13	**$ 15,452.30**	$ 7,683.96	$ 31,771.74
Salt Wetland	Disturbance Prevention, Nutrient Regulation, Habitat, Recreation	10	**$ 12,579.51**	$ 9,991.02	$ 24,457.18
Freshwater or Coastal Embayment	Freshwater Regulation and Supply, Habitat, Recreation, Aesthetic/Amenity	25	**$ 982.73**	$ 64.37	$ 2,985.37
Forest	Climate and Atmosphere, Disturbance Prevention, Habitat Refugium, Recreation	8	**$ 983.56**	$ 406.78	$ 1,997.53
Cropland	Aesthetic/Amenity, Soil Retention, Pollination	3	**$ 1,387.06**	$ 1,387.06	$ 1,387.06
Pasture	Aesthetic/Amenity, Pollination	2	**$ 1,381.16**	$ 1,381.16	$ 1,381.16
Woody Perennial	Pollination	1	**$ 49.42**	$ 49.42	$ 49.42
Urban Green Space	Waste Assimilation, Recreation	3	**$ 3,429.55**	$ 2,691.90	$ 4,167.20

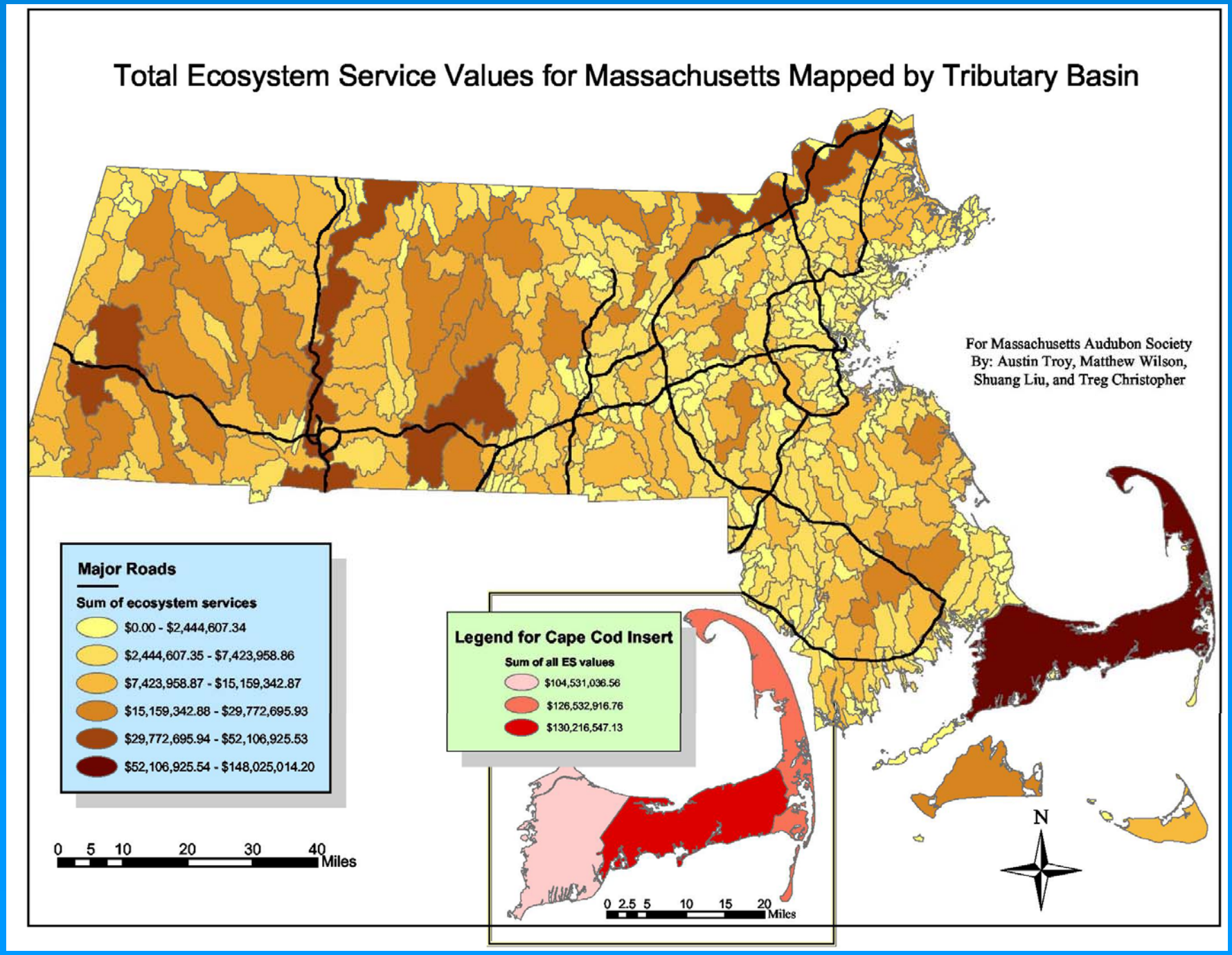
"When these per acre values are applied to the total acreage in Massachusetts for each land cover type, the resulting annual ecosystem service value is over $6.3 billion annually. This figure is in addition to values such as timber and crops. *85% of the non-market ecosystem value created in Massachusetts comes from wildlife habitat* – water, wetlands and forest..." Technical Report for Chapter 6, p.38.

A Decision Tool: Ecosystem Services by Land Cover



Based on 1999 land cover data.

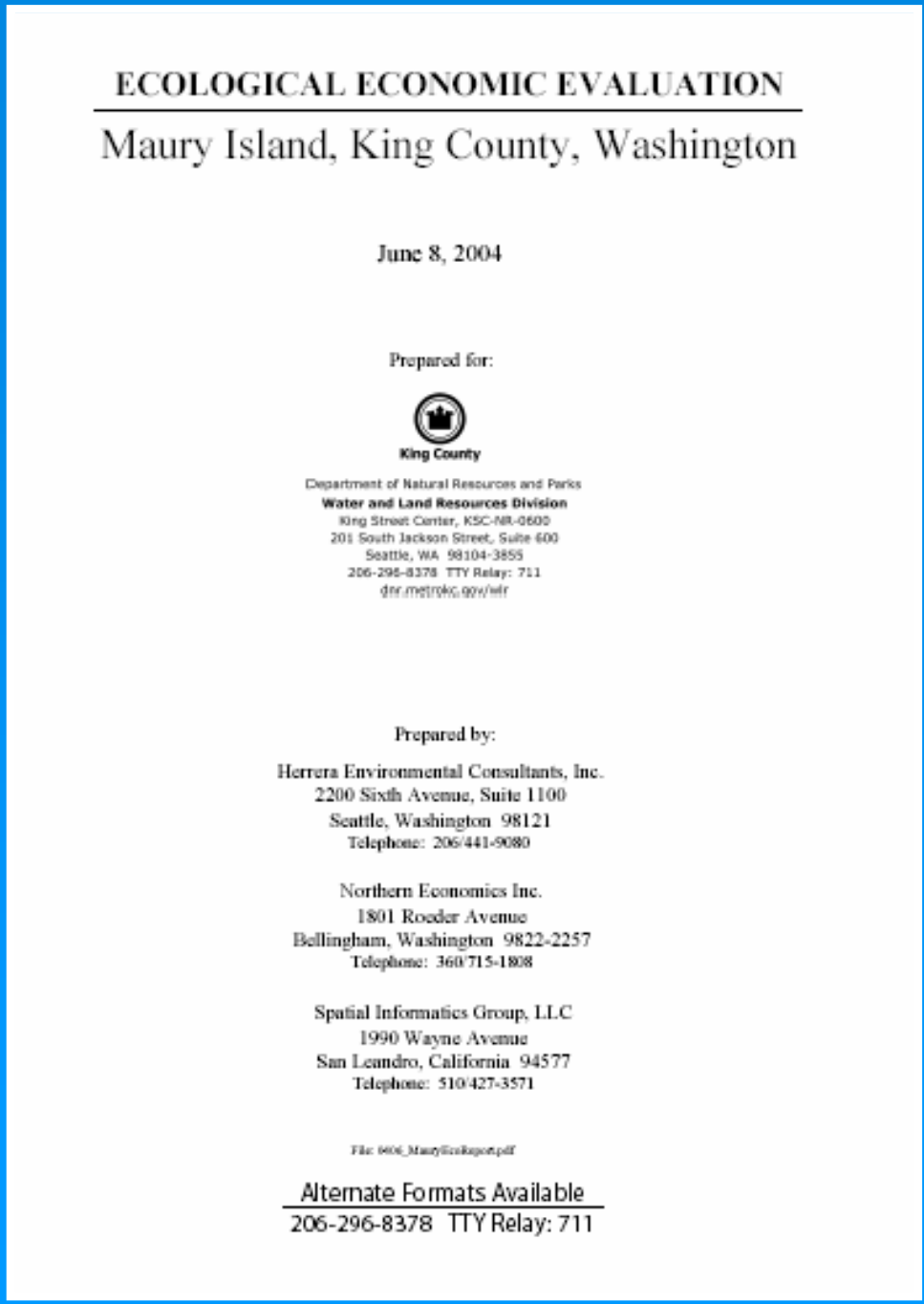
A Planning Tool: GIS Mapping



Maury Island, King County, WA.

- In 2004, Northern Economics, Inc and Herrera Environmental Consultants, Inc. and Spatial Informatics Group, LLC. (www.sig-gis.com) used the NaturalAssets™ information system to analyze the value of the islands natural capital, including nearshore habitat.

- In addition to wanting know about the value of the island's natural capital, the client (King County) wanted to know about the potential effect of a proposed expansion of a gravel mine.



ECOLOGICAL ECONOMIC EVALUATION

Maury Island, King County, Washington

June 8, 2004

Prepared for:

King County

Department of Natural Resources and Parks
Water and Land Resources Division
King Street Center, KSC-NR-0600
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206-296-8378 TTY Relay: 711
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Prepared by:

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Northern Economics Inc.
1801 Roeder Avenue
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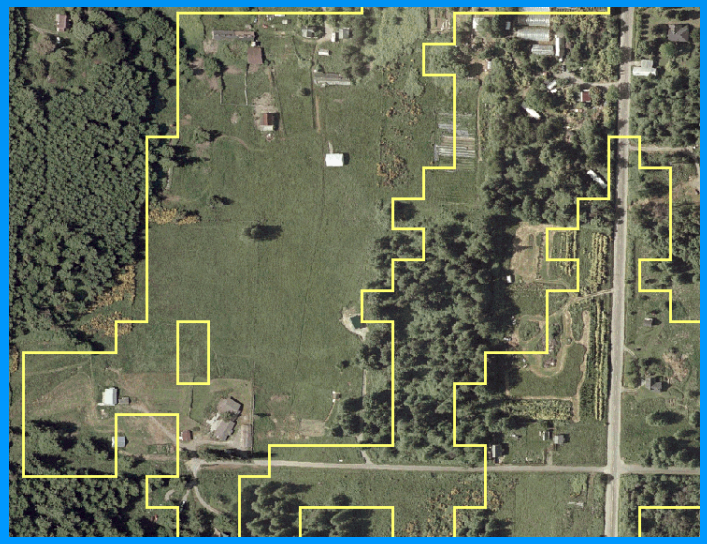
Spatial Informatics Group, LLC
1990 Wayne Avenue
San Leandro, California 94577
Telephone: 510/427-3571

File: 0606_MauryEcoReport.pdf

Alternate Formats Available
206-296-8378 TTY Relay: 711

Report: http://dnr.metrokc.gov/wlr/watersheds/puget/maury-eco-evaluation.htm

- This project involved a complex system of combining coarser land use data with finer scale data on impervious surfaces, nearshore habitat and polygons digitized from aerial imagery



Aggregate Results by Land Cover Type: Maury Island, WA.

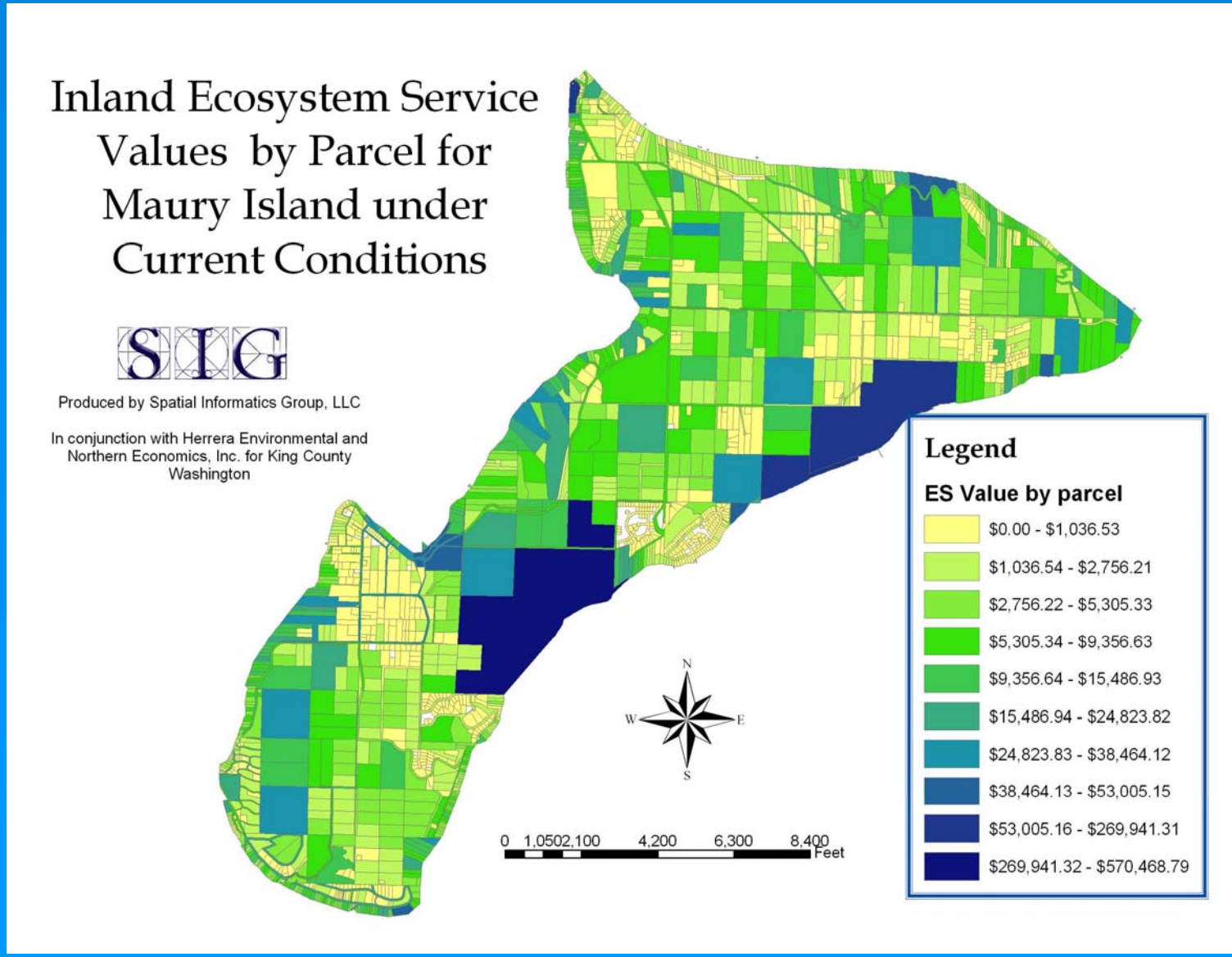
Table 7. Maury Island ecosystem service valuation summary.

Land Cover Type	Ecosystem Value per Hectare	Total Hectares	Total Value for Maury Island Ecosystem
Disturbed	$ 0	253.5	$ 0
Beach	$ 88,203	26.8	$ 2,371,000
Beach near dwelling	$ 117,254	64.6	$ 7,576,000
Coastal Riparian	$ 9,395	132.4	$ 1,245,000
Forest	$ 1,826	1,043.8	$ 1,906,000
Freshwater Stream	$ 1,594	41.4	$ 66,000
Freshwater Wetland	$ 72,786	3.6	$ 269,000
Grassland/Herbaceous	$ 117	321.4	$ 38,000
Nearshore Habitat	$ 16,282	565.2	$ 9,205,000
Saltwater Wetland	$ 1,413	6.7	$ 9,500
Total Value		2,460	$22,685,000

Source: Spatial Informatics Group 2004.

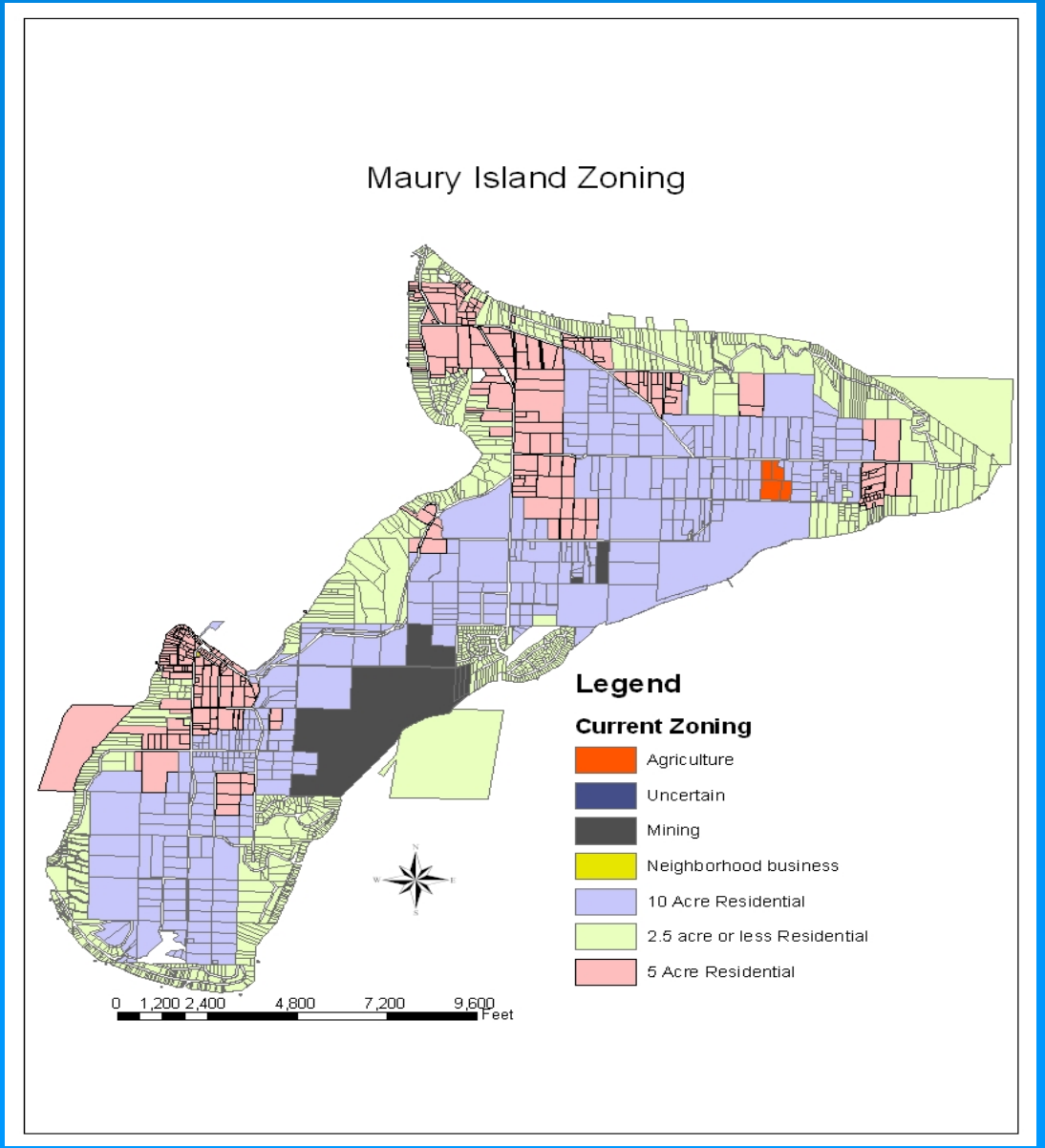
GIS Mapping

- In addition to valuing the nearshore (photic) zone, the team was able to break down ecosystem service values for the island by parcel



Buildout Scenarios

- The team analyzed what ES values would be lost if the mine proposed by the contractor were operated as proposed in the EIS under current Zoning conditions
- Spatial Analysis helped the client (King County) assess what the discounted losses be with the construction of a new dock.



Exciting Times: Future Directions and Challenges

- **Expand Web Deliverable Spatial Value Transfer into an International Context:** Evaluate Ecosystem Services in New Zealand. Collaborators: Dr. Ross Cullen, Dr. Steve Wratten, Dr. Geoff Kerr (New Zealand non-Market Valuation Database)

- **Convergent Validity Tests and Meta Analysis:** Using Choice Modeling in New Zealand and Hedonic Pricing in New Jersey to test the reliability of value transfer estimates

- **Maxmimizing GIS Capability:** Improve our ability to augment value transfer estimates with more detailed socioeconomic and biogeophysical contextual information

- **Proactive Engagement with the Private Sector:** Seek new partners and secure funding sources for innovation in the Methodology—i.e., establishing spatial parameters for market mechanisms such as cap-and-trade.

Thank You!

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