Portland State University

PDXScholar

Institute for Sustainable Solutions Publications and Presentations

Institute for Sustainable Solutions

January 2007

Valuing New Jersey's Natural Capital: An Assessment of the Economic Value of the State's Natural Resources

Robert Costanza
Portland State University

Follow this and additional works at: https://pdxscholar.library.pdx.edu/iss_pub

 Part of the Sustainability Commons

Let us know how access to this document benefits you.

Citation Details

Costanza, R. Wilson, M. Troy, A., Voinov, A., Liu, S., and D'Agostino, J. 2006. The Value of New Jersey's Ecosystem Services and Natural Capital. Report to New Jersey Department of Environmental Protection, Division of Science, Research, and Technology, Trenton, NJ.

This Article is brought to you for free and open access. It has been accepted for inclusion in Institute for Sustainable Solutions Publications and Presentations by an authorized administrator of PDXScholar. Please contact us if we can make this document more accessible: pdxscholar@pdx.edu.

Valuing New Jersey's Natural Capital:

An Assessment of the Economic Value of the State's Natural Resources

April 2007

State of New Jersey
New Jersey Department of Environmental Protection
Jon S. Corzine, Governor
Lisa P. Jackson, Commissioner

Overview of the New Jersey Natural Capital Project

Introduction

New Jersey is blessed with a wealth of breathtaking and highly valuable natural resources. Our beaches, forests, wetlands and other natural resources provide countless benefits to the public. In order to make wise policy, planning, and regulatory decisions, it is important to understand the worth of these resources. This report summarizes the results of a two-year study that aims to quantify the value of these resources. As a way of expressing the value, it estimates the dollar value of the services and goods produced by New Jersey's natural capital. Natural capital consists of components of the natural environment that provide long-term benefits to society. Many of the benefits provided by natural capital come from ecological systems or ecosystems, a dynamic complex of plant, animal, and microorganism communities and their nonliving environment, all interacting as a functional unit. Forests, wetlands, and lakes are examples of ecosystems.

The benefits provided by natural capital include both goods and services. Goods are commodities like timber and fish that can be weighed and transported; most of the goods considered in this study are bought and sold by private parties in market transactions. In contrast, ecosystem services or ecoservices include such things as temporary storage of flood waters by wetlands, long-term storage of climate-altering greenhouse gases in forests and numerous others. Ecosystem services provide economic value both to private parties and to society as a whole.

In this report, the amount of land of ecosystem providing the goods or services is measured in acres and its economic value is expressed in dollars. In addition to the annual dollar value (given throughout the report in constant 2004 dollars), this report also estimates the current worth or "present value" of the natural capital, i.e., the amount of money that would have to be invested now at a given interest rate to generate an equal level of monetary benefits annually. The present values in this report are based on an assumed interest rate of 3 percent per year over an indefinitely long time horizon. The 3 percent rate is the rate most commonly used by economists in converting future benefits and costs to society into present values.

This report is divided into three main parts. Part I presents essential background information, summarizes the detailed findings of Parts II and III and their limitations, and explores in a preliminary way the policy implications of the natural capital project and the future research needs in this area. Part II focuses on ecosystem services and Part III deals with ecosystem goods.

Summary of Part I: Overall Results

Taking the estimated values of goods and services together, the total value of New Jersey's natural capital appears to be about $20 billion per year (present value $680 billion), plus or minus $9 billion per year (present value $300 billion). The annual value of the services provided by New Jersey's natural capital is conservatively estimated at between $8.6 billion (present value $288 billion) and $19.8 billion (present value $660 billion). Freshwater wetlands and marine ecosystems have the highest ecoservice values. The annual value of the goods provided by New Jersey's natural capital is estimated at between $2.8 billion (present value $93 billion) and $9.7 billion (present value $322 billion). Farmland, marine waters, and quarries provide the highest values of goods.

In addition to goods and services provided by our state's natural capital, wildlife-related tourism is estimated to generate about $3 billion of gross economic activity in New Jersey annually. This activity represents about $1 billion of wage and salary income annually or about 37,000 jobs. The jobs are not an additional benefit since the related income is included in the activity figure. Another common benefit measure, namely total value added, which is the annual contribution to New Jersey's Gross State Product, cannot be determined. The net benefits to New Jersey are probably substantially less than these gross values because some of the spending and the related income flow to businesses outside the state. Nonetheless, wildlife-related tourism plays a significant role in the New Jersey economy.

Summary of Part II: Ecosystem Services

In estimating the value of the services provided by New Jersey's ecosystems, the study team used three different approaches: value transfer, hedonic analysis, and landscape modeling.

A. Value Transfer

Value transfer identifies high-quality studies of ecoservices values using a variety of valuation methods and applies the results to New Jersey. Value transfer is the preferred valuation technique where, as in this case, performing original research for an extended geographic region with many varied ecosystem types would be prohibitively expensive and time-consuming. For this study, the research team screened more than 300 studies and selected 100 of them covering the types of ecosystem present in New Jersey. The results of this analysis are summarized below; all figures are in 2004 dollars. A breakdown of values for individual services within the ecosystem can be found in the full report. The figures include only ecosystem services; they do not include ecosystem goods or secondary economic activity related to a given ecosystem.

Wetlands provided the largest dollar value of ecosystem services: $9.4 billion per year for freshwater wetlands and $1.2 billion per year for saltwater wetlands. Valuable service provided by wetlands includes the buffering of floods, storm surges, and other events that

threaten the public. These values were the services of water filtration and water supply for freshwater wetlands, and waste treatment for saltwater wetlands.

Marine ecosystems provided the second-largest dollar amount of ecosystem services: $5.3 billion per year for estuaries/tidal bays and about $390 million per year for other coastal waters, including the coastal shelf out to the 3-mile limit. Nutrient cycling (i.e., waste dilution and removal) was the most important service provided by marine ecosystems, worth $5.1 billion per year.

Forests cover is the largest area of any ecosystem type in New Jersey and provides ecosystem services valued at $2.2 billion per year. Habitat services are currently the most important of these services and are valued at $1.4 billion per year. Other important services provided by forests include water supply, pollination and aesthetic and recreational amenities.

Urban green space covers relatively little of New Jersey but has a relatively high dollar value per acre and provides an estimated $420 million of ecosystem services annually, principally aesthetic and recreational benefits.

Beaches (including dunes) provided by far the highest ecoservice value per acre. Their small area limited their annual ecoservice value to about $330 million, mainly buffering of floods and storm surges and aesthetic and recreational benefits

Agricultural land includes both cropland (estimated at $78 million per year of ecosystem services) and pastureland (estimated at $45 million per year). These values relate solely to the services provided by farmland, mainly habitat services from cropland ($75 million per year) and waste treatment services from pasture land ($26 million per year). These figures do not include the value of the food provided by farms, which is covered in Part III of the report (see below).

Open fresh water and riparian buffers provide services with an estimated annual value of $66 million and $51 million respectively, mainly water supply and aesthetic and recreational. Part III of the report covers the value of the water itself as an ecosystem good.

After studying the state's various ecosystems, the total value of New Jersey's ecosystem services is estimated at $19.8 billion per year. For a number of reasons, the dollar amounts presented above are almost certainly conservative and they understate the true value of New Jersey's ecosystem services. These reasons include gaps in the valuation literature as well as a number of technical factors discussed at the end of Part II of the report.

B. Hedonic Analysis

"Hedonic" analysis is one method that is widely used to estimate the effect of environmental conservation on property values. The term "hedonic" derives from the

Greek word for pleasure (as in hedonism), the idea being that certain environmental features are so attractive that people will pay to be close to them. The approach separates the effect on property values of proximity to environmental "amenities" (such as protected open space or scenic views) from other factors that affect housing prices. In this study, we analyzed the effect on actual residential housing prices of closeness to beaches, protected open space (specifically, large, medium and small parks), water bodies, and unprotected forests and wetlands.

Due to data and resource limitations the team focused on seven local housing markets located in Middlesex, Monmouth, Mercer and Ocean Counties. In the aggregate, those markets are demographically similar to the state as a whole. The results obtained from the analysis generally support the hypothesis that homes close to attractive environmental features usually sell for more than homes further away, all-else being equal. For example, in four of the seven markets, sale prices for homes within 300 feet of a beach were from $81,000 to $194,000 higher than homes more than 300 feet away.

Proximity to lakes and streams can also make homes more desirable. In one of the local real estate markets for which the team had sufficient data, houses located within 100 feet of a water body sold for $33,000 more than homes located more than 100 feet away. In a second market, the difference increased to as much as $92,000 for homes located five miles away from a water body. However, in a third market, homes located 100 feet away from a water body sold for over $63,000 less than homes located 5 miles away. The results for proximity to water bodies thus varied somewhat, and determining the reasons for these differences would require further analysis.

The results for closeness to open space were more complex than proximity to water features because there are many different types of open space. In two markets with sufficient data for analysis, houses located in Environmentally Sensitive zones as defined by the Office of State Planning had selling prices between $8,600 and $34,500 higher than houses not located in such zones. However, closeness to *unprotected* forests and wetlands was consistent in having *no* strong effect on property values across markets.

Closeness to parks (another type of open space) was positively valued in some markets but not others. In the local markets for which sufficient data could be obtained, closeness to small parks tended to have a consistently positively effect on housing prices, while the opposite was true for closeness to medium and large parks. Determining the reasons for these differing results would require additional analysis.

A recognized inherent limitation of this type of statistical analysis is that the results cannot be readily translated into dollar values per acre and so are difficult to compare with the results of the value transfer analysis presented above. The limited tests the team was able to perform to address this problem suggest that the valuations obtained from the hedonic analysis translate into larger per acre dollar amounts than we obtained from the value transfer analysis, suggesting that the latter may be conservative and on the low side, as compared with the "true" values.

C. Landscape Modeling

The type of modeling performed in this study used a landscape simulation model to assess the relationships over time between specific patterns of land use and the production of ecosystem services in watersheds. The model includes variables that quantify how indicators, such as water quality, may vary as land use, climate, and other factors change both in their locations and over time.

The modeling results show that different land use allocations and spatial patterns of land cover can significantly affect the level of ecosystem services. For example, many studies have found that forests in general have beneficial effects on water quality. However, the results, described in Part II, suggest that the effects of forest cover on water quality vary depending different factors. These factors include the total forest cover in an area, the forest configuration (small dispersed forest patches vs. larger forest clusters), forest location relative to other land uses such as farming and to the points where water quality is measured.

There is still much uncertainty in this area. Further studies are needed to take into account the whole range of ecosystem services and to account properly for the precise variations in land cover and ecosystem location, but the results show that patterns of land use can affect ecosystem services significantly.

Conclusions on Ecosystem Services

Ecosystems provide a wide variety of economically valuable services, including waste treatment, water supply, buffering of floods and storm surges, plant and animal habitat, and others. The services provided by New Jersey's ecosystems are worth, *at a minimum*, from $8.6 billion to $19.8 billion per year. For the most part, these services are not currently accounted for in market transactions. These annual benefits translate into a present value for New Jersey's natural capital of *at least* $288 billion to $660 billion, not including marketed ecosystem goods (see Part III below) or secondary economic impacts.

Wetlands (both freshwater and saltwater), estuaries/tidal bays, and forests are by far the most valuable ecosystems in New Jersey's portfolio, accounting for over 90 percent of the estimated total value of ecosystem services.

Higher property values are associated with proximity to beaches and open water. Proximity to open space such as parks and environmentally sensitive areas has positive effects on property values in some local markets but not in others. Positive effects on value are more likely where the open space is legally protected from development.

Summary of Part III: Natural Goods

Ecosystem goods were divided into seven categories: water, minerals, farm products, non-farm animals, non-farm plants, fish, and wood. In each case, care was taken not to double-count ecosystem services covered in Part II. To measure the value of goods we calculated their Total Direct Economic Value. Total Direct Economic Value consists of actual market value plus a quantity known to economists as consumer surplus. Consumer surplus is the difference between the price consumers are willing to pay and the actual price. The method used in this study to estimate consumer surplus is extremely complex and is described in Part III of the report.

Results for Specific Ecosystem Goods

Water Resources Based on information in the 1996 Statewide Water Supply Plan, New Jersey's natural environment provides between 547 and 641 billion gallons of "raw" (i.e., unprocessed) water annually. The Total Direct Economic Value of that water in 2004 dollars is estimated to fall between $262 and $695 million per year. The median estimate is $381 million per year. The present value of annual benefits is between $9 and $23 billion; the median estimate is $13 billion.

Mineral Resources New Jersey's quarries provide commercially valuable amounts of construction and industrial sand, gravel and crushed stone. Based on data from the United States and New Jersey Geological Surveys, the Total Direct Economic Value of that production in 2004 dollars is estimated at between $481 million per year and $1.1 billion per year; the median estimate is $587 million per year. The present value of the benefits is between $16 and $37 billion and the median estimate is $20 billion.

Agricultural Products Based on information from the U.S. Department of Agriculture, the Total Direct Economic Value of the annual output of New Jersey's farms in 2004 dollars is estimated to be between $885 million and $6.5 billion per year; the median estimate is $3.7 billion. The present value of the annual benefits is estimated at between $30 and $216 billion with a median estimate of $123 billion.

Non-Farm Animals Based on harvest data from NJDEP's Division of Fish and Wildlife and retail prices from the U.S. Bureau of Labor Statistics for related meat products (adjusted to approximate wholesale prices), the Total Direct Economic Value of the game animals and birds and fur-bearing animals harvested in New Jersey is estimated to be about $21 million per year. The present value of these benefits is estimated at about $703 million.

Commercial Fish Harvest Based on harvest and price data from the National Marine Fisheries Service, the annual harvest of finfish and shellfish by New Jersey's commercial fishing vessels has an estimated Total Direct Economic Value in 2004 dollars of about $750 million per year. The present value of those benefits is estimated at about $25 billion. Of that amount, shellfish represent about 62percent by weight and 85percent by value.

Recreational Fish Harvest Based on data from various sources, New Jersey's recreational anglers harvest saltwater and freshwater fish with an estimated Total Direct Economic Value in 2004 dollars of about $207 million per year with a present value estimated at about $7 billion.

Non-Farm Plants New Jersey's landscapes provide an unknown amount of useful non-farm plants, including flowers, medicinal plants, and others. The data on these products are meager, and it is not currently feasible to estimate their economic value. Methods are being developed to estimate such values (where volume data are available), but those methods are still in the developmental stage.

Fuelwood In 2003, New Jersey used about 1.6 million cords of wood and wood wastes as an energy source, primarily for electric power generation and residential heating. The share of that fuelwood originating in New Jersey cannot be determined, and this analysis assumes that 100percent of it comes from in-state sources. Based on that assumption and price estimates from various sources, 2003 fuelwood consumption had a Total Direct Economic Value of about $95 million per year, for a present value of about $3 billion.

Sawtimber "Sawtimber" refers to commercially marketable timber other than fuelwood. Between 1987 and 1999, New Jersey's marketable timber resources increased by an average of 204 million board feet per year, of which hardwoods (i.e., deciduous trees) represented about 89 percent.[1] Based on wholesale prices for the various tree species, that annual growth had a Total Direct Economic Value of between $96 and $293 million per year. The median estimate is $147 million per year. The present value of these benefits is between $3 and $10 billion, with a median estimate of $5 billion.

Conclusions on Ecosystem Goods

The values presented above total $5.9 billion per year in Total Direct Economic Value for ecosystem goods with a range of $2.8 to 9.7 billion per year. In terms of ecogoods production, New Jersey's natural capital is worth $196 billion in present value, ranging between $93 to 322 billion. Farm goods and fish command the largest shares, followed by minerals and water; wood and non-farm animals have the lowest shares, and the value of non-farm plants cannot be estimated.

The value provided varies by ecosystem, depending on the types of natural goods provided, total acreage of the ecosystem, and the average value per acre. Farmland and marine ecosystems generate the highest values in terms of total value, followed by barren land (which includes quarries), forests, and freshwater wetlands. In terms of value per acre, barren land ranks first due to the presence of quarries, followed by farmland, marine ecosystems, and open fresh waters.

Conclusion

[1] One board-foot equals the amount of wood in a log measuring 1 ft x 1 ft x 1 in, or 144 cu in.

The results of this study should be treated as first estimates and not as final definitive valuations. They do not include secondary economic benefits supported by direct expenditures on ecogoods, which results in an understatement of economic value. A valuation study such as this one can never be regarded as a closed book, any more than a valuation analysis in business or any other sphere: as conditions change, so do values, and the process of change is continuous. Nonetheless, it is clear that New Jersey's natural capital, both living and non-living, makes a substantial contribution every year to New Jersey's economy and quality of life by providing natural goods worth several billion dollars both annually and in present value terms.