Introduction

Ecosystem services are the benefits that people and businesses receive from a functioning ecosystem. Examples of ecosystem services include adequate supplies of water for domestic and industrial uses; filtration of particulates from air and impurities from rainwater by forests; habitat for birds and wildlife which provide the basis for ecotourism; and wetlands, bayous and water bodies that regulate stormwater and mitigate flooding.

GTRI/HARC was tasked to organize and convene a workshop to bring together regional and national experts to formulate a strategic plan for building regional capacity in the measurement, valuation and use of ecosystem services for public and private decision-making in the Houston-Galveston region. Workshop results included:

- An annotated bibliography categorizing literature according to ecosystem service and valuation technique, with a specific focus on those ecosystem services relevant to the Lower Galveston Bay Watershed; a network of technical experts and stakeholders committed to participate in this capacity-building effort;

- A white paper that forms the foundation and a path forward for building technical capacity in the use of ecosystem services information in decision-making for the Houston-Galveston region and the Galveston Bay watershed; and a

- Network of stakeholders and experts knowledgeable in ecosystem services valuation methodologies and data applications and willing to work in the future to develop and implement an ecosystem services framework for Galveston Bay.

This annotated bibliography is a compilation of journal articles, reports, book chapters, and other literature intended to provide a general background on ecosystem services including the ecosystem services framework, models, tools, and valuation techniques. This bibliography also reviews many works that are specifically related to the socioeconomics and ecosystems of the Galveston Bay region. References used in the related white paper prepared under this contract have also been included.

The annotated references below were selected from a larger database of sources (currently more than 275) related to Galveston Bay ecosystem services. References that were included in the annotated bibliography were selected based on the availability of the resource for review and annotation as well as the resource’s applicability to the Galveston Bay region. Special care was given to include seminal works in the field of ecosystem services. Resources that describe major models and approaches as well as novel methodologies were included.

This is the executive summary of a longer report on the first Australian ecosystem services project. The purpose of the project was to introduce the concept of ecosystem services into government and other agencies. The article focuses on the necessity of a broad base of knowledge for creating an effective market for ecosystem services and the complexities and hindrances associated with the research that was performed. The authors propose policy changes that could increase efficiency, according to their research. The value of production of the 2.4 million hectare area was $8709 million in 2001 and growing.


This report chapter summarizes the relationship between the world's coastal ecosystems and human well-being. The authors describe where human populations live in relationship to coasts: 76% of the world's population lives within 50 km of the coast, 1.6 billion people, or 27% of the world's population, lives within 50 km of an estuary, 12% percent near coral reefs, 18% near mangroves, and 19% near seagrass. The authors also present a summary of the literature on market and non-market values of coastal ecosystems services. They estimate that 61% of GNP comes from within 100 km of a coastline. The chapter concludes with a discussion of the drivers of coastal ecosystem change, the current status and trends, and future management options for coastal systems.


The authors use the Integrated Coefficients Method to analyze different management scenarios for coastal zones in Brazil and Spain. They conceptualize the study area in terms of the various sectors that comprise it: industry, tourism, fishing, aquaculture, ports, agriculture, etc. These are aggregated into an objective function with positive and negative values assigned based on each sector's various activities; specifically, how their activities relate to each other and to the coastal ecosystem (aka net socioeconomic benefit function). Activities related to each of the production sectors are optimized based on the management scenario under consideration. For this study, the authors considered water quality as the indicator for environmental quality and quantified the relationship with each sector based on that assumption. The authors found that for the two case studies, the marginal cost of treating 1 m3 of water is less than the marginal benefits obtained from 1 m3 of purified water.


The authors develop a method for comparing benefit transfer to original valuation research. The authors find that due to the estimation errors inherent in benefit transfer, when evaluating benefits with a NPV of $>500,000, original valuation research should be utilized. The increased accuracy of original valuation studies will deliver economic returns due to reduced decision errors. This equation is utilized when estimating the effects of environmental quality on recreation opportunities, but could theoretically be applied to various types of ecosystem services.
This study found that rice production is falling in Texas. Because rice acreage and wetlands provide similar benefits for waterfowl, the reduction in acreage is correlated with a decline in migratory waterfowl populations. Waterfowl hunting in the rice belt generates $5-$8 (in 2000$) per acre of rice fields. There are also potential benefits due to bird watching, but this has not been quantified for the Gulf Coast. The most common barrier to rice farmers participating in environmental programs was lack of knowledge of the program. They conducted a meta-analysis of wetland valuation studies to use as guidance in valuing rice fields. The study found a wide range of values for flood regulation benefits, water quality and quantity, recreational and commercial fishing, bird hunting and bird watching, cultural amenity, habitat, and storm protection. Wetland valuation cannot be substituted for rice acreage valuation because of the diminished quality of rice fields compared to wetlands. While the authors present the findings of their non-market wetland valuation meta-analysis, they hesitate to choose a value to represent the non-market value for rice acreage.


This analysis looked at the loss of tree canopy in the Houston metropolitan area from 1972-1999. The study found that there was a major loss of tree canopy cover over the 27-year period. The study attempted to monetize the loss of tree canopy cover and found the following: $38 million in lost scrubbing of air pollutants, loss of $237 million in infrastructure to contain stormwater flow, loss of summer energy savings of $26 million annually. Additionally, the study presents figures for tons of carbon storage. Potential issues with this analysis is double counting of forest cover benefits.


This study looked at general ecosystem services from coastal lagoons. The paper categorizes social values as pragmatic, scholarly, inspirational, and tacit. Pragmatic values are considered use values. Scholarly values are part of efforts undertaken to increase our knowledge. Inspiration values are those belonging or revealed through creative production. Tacit values are those that are intangible, such as views or sounds. These values are then linked to a variety of valuation methods. The main point is to urge coastal managers to consider a wider range of social values.
services: a guide to models and data, version 1.0. beta ARIES report series n.1. (pp. 128): The ARIES
Consortium.

ARIES is a modeling platform that creates ecosystem service models by incorporating a collection of
existing models described by user input and ad hoc models where an existing model does not exist. The
ad hoc models in ARIES were constructed using Bayesian probabilistic approaches for addressing
uncertainty. ARIES uses agent-based models to map ecosystem service flows in the environment,
capturing sources, users and sinks of services across the landscape. The model is supported by hundreds
of spatial layers at many geographic levels and locally specific data can be added by the user. The model
can be accessed and run through a web platform so that data processing and results does not require
proficiency in spatial software or other modeling software. ARIES also takes into account spatial
dynamics of ecosystem services, i.e. where the users are located relative to the services. This model is
very powerful, but like any model, relies on a good description of input parameters, thus, lack of
sufficient data will cause many uncertainties in model output.

Bahn, H., Blanche, C., Bowers, M., Hegg, R., Hipp, J., Jerkins, D., Mertz, B., Norland, E., Rozum, M. A.,
Throwe, J., & Williams, B. (2007). Ecosystem services discussion paper (pp. 36): Cooperative State
Research Education Extension Service (CSREES), Ecosystem Services Working Group.

The Cooperative State Research, Education, and Extension Service (CSREES), a program under the
USDA, believes that human well-being is inextricably linked to agroecosystems and a balanced approach
to their management is vital to the future of agriculture. The paper lays out the ES research portfolio to be
adopted by CSREES in relation to strategic goals 3 & 6 outlined in the USDA’s strategic plan:
“Supporting Increased Economic Opportunities and Improvised Quality of Life in Rural America” and
“Protect and Enhance the Nation’s Natural Resources Base and Environment.” The portfolio would
manage for “Multifunctional Agriculture” and would integrate existing programs that are focused on
single services (air, water, etc) into multi-service programs such as energy flows, land use changes,
environmental health, etc. The paper lays out a detailed portfolio structure for a new ecosystem services
approach.


This article by Barbier is a theory-based examination of the valuation of multiple ecosystem service
functions for tropical wetlands. Specifically, the article considers trade-offs between conserving and
converting wetlands. The paper builds a simple mathematical model and considers two production
activities: one based on resources from the wetlands to produce a commodity and another activity that
directly uses remaining resources, or is indirectly supported by protection resources. The model is not
solved with data. The paper then more closely examines the limitations of using a production function
approach. Production function approaches are more easily used with single-use systems, but can be used
with multiple-use systems, as well. Two identified difficulties include double counting and tradeoffs
between direct and indirect uses. Benefits must be carefully considered to disentangle and correctly
allocate benefits. Another consideration is to ensure that the link between ecological functioning and the
economic activity produced are well understood.

ground: wetlands, hurricanes, and the economy: the value of restoring the Mississippi River Delta (pp.

This study used benefit transfer to estimate the value of all ecosystem services in the Puyallup River
Watershed - range of $13 to $120 billion. The region was divided by different types of land covers, the
area of each land cover was found, and the high and low value of each type of land cover was estimated

Galveston Bay Ecosystem Services Annotated Bibliography
through benefit transfer. The land cover is mostly forest and urban. This study did not include the value of every ecosystem service provided in the region, so the value is most likely an underestimate. The report identifies problems such as flooding that can be mitigated with the application of this research and investment in green infrastructure.


This study used benefit transfer to estimate the value of all ecosystem services in the Puyallup River Watershed to be between $13 billion and $120 billion. The region was divided by different types of land covers, the area of each land cover was found, and the high and low value of each type of land cover was estimated through benefit transfer. The land cover is mostly forest and urban. This study did not include the value of every ecosystem service provided in the region, so the value is most likely an underestimate. The report identifies problems such as flooding that can be mitigated with the use of this research and investment in green infrastructure.


This article built a mathematical model for estimating the economic value of saltwater marsh contributions to recreational fishing. The paper builds a bio-economic model for the theory. However, a Cobb-Douglas functional form is used for the actual estimation. Their estimates are then compared to land values from recent purchases. They conclude that the state might benefit from purchasing more coastal land for preservation based on the estimated value of ecosystem services compared to land sale prices.


The authors propose a new model of valuing saltwater beach days. They reject the traditional travel cost method because of its spatial limitations and propose a new "on-site" demand curve. The authors surveyed motorists and airport travelers in Florida. First, they split recreationists into 2 groups: tourists, or those who travel a great distance to beaches, and residents, or those that travel a relatively short distance to use the beaches. They argue that the travel cost method does not account for multi-day trips, which makes it inapplicable to many tourists that come to Florida. The authors found the daily consumer surplus for saltwater beach days is $34 (in 1990 dollars), with a total annual value of $2.374 billion and a per acre value of saltwater beach of $8.8 million.


The authors used regression analysis to measure the impact of water views on single family homes. They looked at a period of home sales from 1984-1993 in Bellingham, WA, a city located on Bellingham Bay. The authors determined that a water view increased the home's value by 8-59% in 1993. The study used a qualitative assessment based on quality of view (good partial view, poor partial view, full view, etc.) combined with other common real estate variables such as acreage, square footage, number of rooms, etc. Poor partial view = 8% increase in home's value, good partial view=29% increase, unobstructed ocean view=59% increase and lake frontage=127% increase. The value of a view decreases as the distance from water increases.

This study combined actual and intended travel behavior models to estimate recreational fishing benefits of estuary restoration and protection in the Lower Atchafalaya River Basin estuary in Louisiana. The authors analyzed the change in the number of fishing trips taken by coastal anglers in relation to their catch rates of redfish and speckled trout. The authors used the travel cost method to make real estimates of the value per angling trip and a trip response model to predict intended visitation behavior (stated preference approach). The study found that recreational anglers had willingness-to-pay (WTP) of $31 per trip. Using a mean value of 16 angling trips per year, the annual net WTP for anglers is $493. This is consistent with results from the Industrial Economics study in the Barataria-Terrebonne area ($27/trip) and the Peconic Estuary value of $44/trip (Johnson et al.). The authors note that recreational fishing benefits estimations are likely to vary across different coastal regions of the US.


The Habitat Conservation Blueprint was initially conducted in 1998 to identify and inventory potential restoration sites throughout the Galveston Bay complex. Stakeholders identified 167 sites in Galveston Bay, East Bay, the San Jacinto River, Trinity Bay and West Bay as potential restoration sites. The initial blueprint provided a description of the site, site location, land ownership and possible restoration strategies. The sites were geo-referenced and added to a GIS database. The 2007 update to this plan provided updated GIS quadrants and satellite images to provide resource managers information about site conditions and restoration or conservation activities on-going at each site. A survey and meetings were conducted to determine any updated site information and consider new sites. This could be a valuable tool in identifying and prioritizing areas of existing or potential ecosystem service value.


This paper describes the meaning of economic value, how to frame the valuation question (i.e. value is contextual), and the different valuation techniques used by economists when valuing ecosystems. The authors argue that it is not good enough to simply say an ecosystem has value, but that is important to correctly calculate people's values. They offer criticisms of past valuation techniques (most notably the work of Costanza et al.) and describe the difficulties in valuing ecosystems. The authors believe that cooperation amongst ecologists and economists is key to accurate valuation of ecosystems.


This paper looked at real estate transactions in three cities in New Zealand from 1986-1996 to determine the prices of a water view. The authors used regression analysis to determine the value of water views in dollars (1996 New Zealand Dollars [NZD]) and as a percentage of the home's value. The authors found that availability of water views is inversely related to the price, such that in Christchurch which has a limited number of homes with water views, water views are worth much more than in other cities. From 1986-1996 water views in Auckland ranged from $15,830-$24,393 (1996 NZD) constituting 8.6-11.2% of a home's sale price. Christchurch water views ranged from $10,629-$19,886 (1996 NZD) constituting 8.1-13% of a home's value. Wellington, which has a large number of homes with water views, ranged in value from $8,586-$15,541, or 4.6-8.5% of a home’s sale price.

The authors describe a narrow definition of ecosystem services, namely those services that are identifiably "ecological," as opposed to recreational benefits or commercial harvests. They do so for the purpose of creating a measurable accounting unit for ecosystem services, or "green GDP". Green GDP would be calculated by aggregating marginal WTPs for all market and non-market final ecosystem services which "yield human well-being." Green GDP should not account for ecosystem services already captured by GDP. The authors make a distinction between the quantity of the ecosystem service and the value of the service (price and quantity), a distinction, they argue, that has not been clearly made in previous ecosystem services work. This paper advances theory in practical accounting of ecosystem services, but does not proffer any WTP measurements or weights for any specific service.


This article presents a survey of various methods used to value ecosystem services (ES) from wetlands. In particular, this paper assesses uses and limitations from the use of ES valuations. The focus is on non-market valuations and the methods include hedonic, travel cost, replacement cost, production, and survey methods. Objections to these approaches are reviewed and include: 1) valuations are anthropogenic, 2) objections to commoditizing ecosystem services, and 3) impossible to account for full complex range of services produced from wetlands. The paper concludes with a discussion of challenges facing ecosystem services valuation. These challenges include gaps in understanding of ecosystems, difficulty in calculating options value for irreversible losses, and scale problems with the analysis. The authors conclude by stating the need to continue producing well-implemented, site-specific research to determine both functions and values.


The authors conducted a meta-analysis of wetland valuation studies. The paper examines 190 studies which provided 215 value observations. The meta-analysis also includes variables for GDP per capita and population density. The study then assesses the validity of conducting value transfers based on the meta-analysis. Significant findings from the study include that there are decreasing returns to scale for wetlands. The study found a positive correlation between GDP per capita and population density. Finally, the study found that valuations from contingent valuation methods (CVM) tended to be higher than from other valuation methods. In regards to using value transfer from the meta-analysis, the study found an average error of 74% compared to transfer errors associated with other studies in the literature. This indicates the need for caution in using meta-analyses as well as a need for more primary studies.


This article estimated the value of wetlands with regard to provision of wastewater treatment services for three case studies in Louisiana. The article looks at four specific benefits from wetlands: 1) reduced costs of treatment compared to traditional methods, 2) improvement of water quality discharge of receiving wetlands, 3) levels of treatment may exceed levels attained by other methods, and 4) natural wetlands may yield improved water quality of effluents into surface water. The estimates of benefits ranged from $785 to $34,700 per acre.

The authors examined the impact of Section 404 wetlands permitting from 1991-2003 on naturally occurring wetlands along the Texas and Florida coast. In Texas, approximately 12-13,000 wetland permits were issued during this time period, with 38.5% located in the 100-year floodplain. In Texas, authors found that 78% of wetland permits were issued in non-urban areas, reflecting the sprawling growth patterns along the Texas coast. The authors caution that although wetland mitigation efforts are supposed to occur at a 2:1 ratio with naturally altered wetlands, many scientists question the quality of a created wetland compared to a natural wetland. Created wetlands do not offer the same flood mitigation benefits as created wetlands due to a loss of hydrologic function. Additionally, mitigation wetlands are often not required to be the same type of wetland and because mitigation is most often off-site, the created wetland may not be delivering the same amount of benefits as the naturally occurring one due to its location. The authors conclude that, due to a lack of comprehensive planning along the Texas coast, palustrine wetlands and their associated benefits will continue to be lost.


The author begins by giving an overview of environmental value transfer and its current and potential uses. He notes the controversy surrounding benefit transfer and compiles a table of transfer error studies and discusses the reasons for errors in benefit transfer. The author then defines a 7 step protocol for good practices in environmental benefit transfer. These steps are: 1) Defining the environmental goods and services, 2) Identifying stakeholders, 3) Identifying values held by different stakeholder groups, 4) Stakeholder involvement in determining the validity of monetary environmental valuation 5) Study selection, 6) Accounting for methodological value elicitation effects, and 7) Stakeholder involvement in value aggregation.


The Council on Environmental Quality’s proposed objectives for water resource planning outlines the importance of water to human health and the environment and establishes principles which must guide water resource implementation studies. The report emphasizes the need to characterize ecosystem services in assessing water-related plans and projects and in the report’s planning principles the authors explicitly state that agencies must: “account for ecosystem services” and “account for the benefits and costs in appropriate monetary and non-monetary term.” The authors believe that consideration of ecosystem services can play an important role in evaluating water resource alternatives and in evaluating the value of changes in water quantity and quality over time. Inclusion of ecosystem services language in these standards highlights the recognition of ecosystem services at the top levels of government.


This article discusses the potential economic gains from investing in ecosystem services instead of grey infrastructure. The article describes New York City's decision to save $6-8 billion from the construction of a water filtration plant, by spending much less ($1-$1.5 billion) on a natural water purification system. The authors discuss the potential for savings or profits from the biosphere.

This article is a seminal work in the field of ecosystem services valuation. Costanza et al. utilize benefit transfer and a few original valuation calculations to estimate the ecosystem services of 16 biomes, spanning the entire plant. The value for the entire biome was US $16-54 trillion/year, compared to global GNP of US $18 trillion. This study elicited controversy in the environmental economics field due to the broad use of benefit transfer. This article serves as a starting point for the discussion of natural capital valuation and the need for more research. The ecosystem services and functions utilized in this article form the basis of the MEA framework.


This study examines the value of coastal wetlands in providing protection from hurricanes. It improves over previous hurricane studies by using more spatially explicit data on hurricane tracks, wetlands area, and GDP. The study uses a two step process to formulate the estimates. The first step is to perform a regression analysis using relative damage as the dependent variable and wetland area and wind speed as the independent variables. The second step uses the results from the first step combined with estimates of annual hurricane frequency to develop annual values of wetlands protection. This value equates to the value of damage avoided for maintaining larger areas of coastal wetlands. The study estimates a wide range of marginal values. The value estimated for Louisiana is $1,700 (in 2008$) per ha per year.


This paper aims to assess potential effects from sea-level rise on tidal marsh ecosystems. It makes use of the Sea-Level Affect Marshes Model (SLAMM) to evaluate impacts. The model uses IPCC scenarios as input. Impacts are given as changes in area for different marsh types. While no values are estimated, the SLAMM is demonstrated to be a useful tool.


This book is organized in three parts. First are chapters dealing with the underlying framework for thinking about how the built environment should be reshaped considering the ecological, ethical and economic underpinnings for sustainability. Second, there are chapters considering the energy, water, materials, land and landscape resources that are the “stuff” of the built environment. Lastly, the book discusses “process” and provides insights into organizing and designing structures in a fashion that carries out this reshaping to the benefit of both humans and natural systems.


This paper proposes a conceptual framework and strategic vision for implementing the concept of ecosystem services based on examples from Hawai‘i. The authors describe key advances in the science of and accounting for natural capital in the decisions of individuals, communities, corporations, and governments.

This article examines the use of both natural and created salt marshes near the Aransas Natural Wildlife Refuge in Texas. The authors found that bird use of created salt marsh islands was dominated by perching birds, rather than waterbirds. This was due to the altered geomorphology of created salt marshes compared to natural marshes. Available habitat types differed on the created salt marshes, where vegetation had overgrown the shallow-water and exposed habitats favored by waterbirds. This article points to the fact that created salt marshes do not always provide the same ecosystem services as natural marshes, and great care should be taken in the design of salt marshes so they serve their intended purpose.


This paper offers a thorough examination of the need and process for valuing ecosystem services from wetlands. The paper first summarizes what valuation means, when it should be done, and how it can be used. The paper then offers a 5-step framework for conducting wetland valuation. The five steps are: 1) policy analysis, 2) stakeholder analysis, 3) function analysis, 4) valuation of wetland services, and 5) communication and dissemination. The valuation step involves identifying a measurable indicator for each ecosystem service. The paper only offers brief descriptions of valuation methods. An appendix to the report contains several case studies on actual use of valuation studies including studies from El Salvador, Uganda, Cambodia, and Portland, USA.


This article is a precursor to the Millennium Ecosystem Assessment (2003) and provides a framework for ecosystem service classification that closely mirrors that found in the MEA. The authors differentiate between ecosystem functions (regulation, habitat, production and information), processes, and goods and services (those which increase human well-being). As with previous authors, they divide ecosystem value into ecological, socio-cultural, and economic value and discuss the common valuation techniques (contingent valuation, group valuation, indirect market valuation and direct market valuation) for measuring value. The authors go on to provide a matrix which matches each ecosystem function to the most appropriate, or most utilized, valuation technique.


This report describes the economic impacts of travel to and through Texas and the state’s metropolitan areas, tourism regions, counties, and selected cities and places. The estimates of the direct impacts associated with traveler spending in Texas were produced using the Regional Travel Impact Model (RTIM) developed by Dean Runyan Associates.
This chapter in the MEA gives an overview of data and methods used to assess ecosystem services. The methods and data sources most often utilized are broadly defined as: Remote Sensing and GIS, Natural Resource and Biodiversity Inventories, Socioeconomic Data, Ecosystem Models, Indicators of Ecosystem Condition, Indigenous and Traditional Knowledge, and Case Studies of Ecosystem Response. The chapter goes on to give detailed descriptions of these data sources and methods and how they have been translated into the Total Economic Value framework for the MEA.


This case study investigates the use of the benefit transfer method for ecosystem services valuation in assessing damages from the Exxon Arthur Kill Oil Spill. The research performed by Exxon valuates damages done to services provided by wetlands and to recreation on the coast. The wetlands were determined to provide regulating and cultural services in the form of water purification, education, and primary productivity. The benefit transfer method was used due to the low cost of this technique and the ability to complete the valuation in the small amount of time available during the negotiation of the settlement.


This study looked at economic impacts of sport diving in Texas. The authors surveyed 528 sport divers. Most divers (75%) did not participate in spear fishing, thus the majority of divers were participating in "appreciative" activities. The study used two different estimates for diver offshore trip days (1,985 and 5,953). The average per trip expenditure for Texas residents was $162, with aggregate expenditures of $261,439 and $784,106 in coastal communities. Non-Texas residents spent $58,885 to $176,606. Expenditures in coastal communities were typically in the form of charter fees, lodging and restaurant meals.


This is a strategic planning document for the Department of Interior for FY 2007-2012. The strategic plan represents the linkage between the agency’s goals and its budget for the planning period. This document is important for the development of ecosystem services because of End Outcome Goal 4: the understanding of national ecosystems and natural resources through integrated interdisciplinary assessment. “The absence of a consistent method for assessing [environmental] amenity values across BLM lands prevents decision makers from understanding the scope and magnitude of the full set of values associated with these lands.” This document is important because it indicates the DOI’s commitment to furthering ecosystem services studies on BLM lands.

This article presents a method for testing the reliability of the benefit function transfer approach using contingent valuation methods. Data are collected from anglers surveyed across eight Texas Gulf Coast bay regions over three time periods. Results show that the benefit function transfer approach may overestimate benefits. The authors state that the benefit function transfer approach is not a reliable method for the case of recreational saltwater fishing in Texas.


The majority of large landowners indicated hunting and providing habitat for fish and wildlife were important. Landowners throughout the survey supported management and conservation of habitat 2 to 1 over opening up properties for recreation. One in three large landowners were interested in forms of outdoor recreation other than hunting, and 1 in 10 were "very interested" in opening their land. Extrapolated statewide, this represents 14 million acres that could be made available by "very interested" landowners. These other forms of nature tourism, such as fishing, camping, hiking and wildlife watching, also found one in three interested in providing access in exchange for tax breaks or other incentives.


This paper attempts to estimate losses of ecosystem services related to losses of coastal wetlands in the Gulf of Mexico. The authors reviewed the literature to ascertain the values of coastal wetlands in four areas: commercial and recreational fishery support, storm surge protection, nitrogen removal for water quality regulation, and carbon sequestration related to greenhouse gas regulation. No monetary valuations are estimated but Engle provides quantitative results for wetland nitrogen removal rates, carbon accumulation rates, per ha fisheries landings, and storm surge reduction.


This report was a collaborative effort by the EPA's Scientific Advisory Board to improve the use of ecosystem services valuation at EPA. The report begins by critiquing past assessments which did not adequately address uncertainty and often ignored important, but hard to measure ecological services. The authors examined ecological valuation practices, methodologies and research needs with respect to agency valuation of services. The board recommends that EPA develop a conceptual model of relevant ecosystems and services, develop new approaches to measure ecosystem services, and utilize a broader array of valuation techniques. Valuation techniques should include not only economic methods, but biophysical ranking methods, decision science approaches, civic valuation, measure of preferences, etc. Finally, the committee recommends that EPA use the valuations for national rulemaking, regional partnerships, and site-specific decisions.


This website gives background and research objectives for the EPA's Ecosystem Services Research Program (ESRP). This page links to factsheets, publications, FAQs and other links related to the program or to ecosystem services valuation, in general.

Chapter 2 of Esposito’s thesis discusses a rapid assessment technique for ecosystem services valuation. This method was employed for a case study involving a natural gas pipeline project in Peru's untouched Amazon rainforest. This assessment examines many different scenarios of development and the environmental, economic, social and political impacts of the project. This chapter outlines the need for fully informed decision-making and inclusion of local communities when considering major construction projects.


This article outlines the ecosystem-services based management approach. They review the ecosystem functions and services outlined in the Millennium Ecosystem Assessment. The authors provide a useful table ranking the ease of evaluation of each type of ecosystem service, the most appropriate method of valuation, and transferability of valuation across sites. The authors use this approach to evaluate three Long Term Ecological Research (coastal, urban and agricultural) sites in the US, measuring change in services (S) and the average value per unit of service (V). Attention is given to weighting of more critical services, as well as accounting for the change in marginal value of a service over the range of service change (a service becomes more valuable as its scarcity increases or as no easily available substitutes can be found). The authors also conduct a hypothetical valuation for an agricultural area in Iowa using this approach and valuation transfers from the literature.


This paper provides a general overview and background for ecosystem services based valuation with a discussion of economic and ecological concepts of value. The authors examine the different valuation methods typically utilized and the challenge of aggregating these values. This is a good overview of the theory underlying ecosystem services valuation.


This paper discusses the two different approaches to the Payment for Ecosystem Services (PES) method and reviews the literature on the topic. The environmental economics approach uses the market model, emphasizing economic efficiency. The ecological economics approach prioritizes sustainability and equal distribution of services through a multi-disciplinary approach. The paper summarizes the principles underlying the PES approach including improving upon measurements of services, bundling services, defining appropriate spatial and temporal scales for management, establishment of property rights, distribution of costs and benefits, sustainable funding for PES systems, adaptive management, education of the public and elected officials, participation by all stakeholders, and inclusion and coherence within existing policy instruments. The authors note that PES requires excludability and rationing of rival and scarce resources to be efficient in a market context, but may require democratic intervention to insure a desirable distribution of benefits.

The authors explore the ecological and economic effects of projected Intergovernmental Panel on Climate Change (IPCC) 2007 report sea level changes at the plant community scale. Findings show that salt marshes do not always lose land with increasing rates of sea level rise. The authors found that the lower bound of the IPCC 2007 potential rise (0.18 m by 2095) increased the total marsh area, potentially resulting in a net gain in ecosystem service values on public property and market-based economic losses for private property. The upper rise scenario (0.59 m by 2095) resulted in both public and private economic losses for this same area. This work highlights the trade-offs between public and privately held value under the various IPCC 2007 climate change scenarios. The authors conclude that as wetlands migrate inland into urbanized regions, wetland survival will likely be dependent on the rate of return on property and housing investments.


The author begins by summarizing the basics of ecosystem services and the need for spatially explicit quantification of services. Because the nature of ecosystem services valuation is interdisciplinary, the goal of their project was to create an open source geospatial website where modelers could easily share and access geospatial data and models in a standardized format. The authors utilized the Prairie Pothole ecosystem to demonstrate integrated wetland ecosystem modeling, implementing five different models of ecosystem processes: evapotranspiration, land terrain, wetland water table, water surface extent, and waterfowl estimations. The model and data services are hosted on the Geospatial Model Service Interface (GeoMSI), a WPS profile that is customized for sharing ecosystem services models. The interface utilizes an OGC WPS (Open Geospatial Consortium, Web Processing Services) standard to ensure interoperability when using various hardware and software. The authors believe that sharing and integrating models through network services is an important step in the analysis of complex ecosystem services. This type of technology could help reduce costs of an ecosystem services study by using existing, standardized models and datasets.


This volume provides an overview of the methods and techniques of resource valuation for professionals. It covers recent developments in theory and methods underlying the practice of resource valuation. These topics include: model specifications and econometric estimation methods for nonmarket valuation, benefit transfer, combining stated preference and revealed preference data, and valuing ecosystem services.


This paper represents a first attempt at including risk into a linear programming model designed to describe the net revenue of a firm. Using risk in describing net revenue is important because different scenarios can be described for a person that is risk-averse, risk neutral and risk-loving. The application of this principle to ecosystem services is evident in the decision support tool methodology. This utilizes different risk scenarios to help build a portfolio of land use planning alternatives. In the E-V model a
decision is made solely on the basis of the expected payoff and the uncertainty of that payoff. The portfolio analysis provides a way to estimate the tradeoffs of use values.


This paper outlines a process for estimating water quality in Chesapeake Bay by using land use/land cover maps. Utilizing stepwise logistic regression methods the authors found that stream health was primarily determined by the amount of impervious surface in the watershed. To achieve “excellent” stream health the impervious land cover would have to be restricted to just 6% of overall land cover and streams in the watershed would need to maintain 65% vegetative cover in stream buffer areas (30 meters either side of stream). To achieve “good” stream health, they advised no more than 10% impervious cover and a 60% vegetative cover of the buffer area.


This paper compares Nature Conservancy projects that focus on biodiversity (BD) only with ecosystem services (ES) projects to see if ES projects do an adequate job of protecting ecosystems. The authors found no significant differences between BD and ES projects with respect to these 3 issues: do ecosystem services projects address the most pressing threats to biodiversity; do ES projects lead to establishment of protected areas; and do ES projects lead to long-term conservation? Some advantages of ES are they target a broader array of agricultural landscapes, allow continued, sustainable use of these lands, and introduce a wider range of private funding sources. The authors emphasize the use of local independent leadership, government support, and engagement of a wide array of stakeholders.


The authors surveyed 600 households in Puerto Rico to ascertain willingness to pay (WTP) for preservation of instream flows in the Rio Mamayes and avoid building a dam on the Rio Fajardo. The method used was an in-person, dichotomous choice, contingent valuation survey with multiple, bounded bid amounts. Respondents were given 5 brackets to choose from with WTP amounts ranging from $1-$225. The annual household WTP for the Rio Mamayes was $27, and $28 was the household WTP for the Rio Fajardo. When expanded to the entire population this totals $11.33 million for Rio Mameyes and $13.09 million for Rio Fajardo. The combined household WTP for both programs was $31 ($13.09 millino for Puerto Rico). The authors experienced issues with many protest responses due to extreme distrust of the Puerto Rican water agency by Puerto Rican citizens. The authors conclude with suggestions for alternative ways to meet water demands in Puerto Rico including repair of water lines, reducing illegal connections, dredging of reservoirs to increase storage capacity, and replacement of inefficient showers and toilets.

The goals of this study were to promote biological health, water quality, and long term management efforts in Tillamook Bay while minimizing adverse effects to residents, gaining public support, and minimizing costs. At the same time, the study strove to encourage public involvement in the initiative. A contingent valuation method of surveying stakeholders was used to determine the willingness to pay to "protect and restore tidal wetlands," "upgrade forest roads," or "limit livestock access to streams." Of the people surveyed, 47% chose protecting and restoring tidal wetlands to be the most important action. Of those, most valued each acre at $5000 (in 2001$). An important benefit to citizens of restoring tidal wetlands was increased floodwater storage, and an important cost of limiting livestock access to streams was the loss of farmland.


This report contains two forecast products, a forecast for 8 counties (Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller) in the H-GAC Transportation Planning Area, and a forecast for the remaining 5 counties (Austin, Colorado, Matagorda, Walker, Wharton) in the H-GAC region.


The Eco-Logical project utilized a GIS based mapping tool to help identify environmental resources in the 8 county H-GAC planning region. A metric was used to score high value environmental resources with the goal of integrating this metric into the transportation and environmental planning processes, and ultimately conservation of high value environmental resources. Next steps in this project are to refine ecotype delineations and local icons. This tool has good potential for use in an ecosystem services assessment of the region.

Haby, M. G., Miget, R. J., & Falconer, L. L. (2009). Hurricane damage sustained by the oyster industry and the oyster reefs across the Galveston Bay system with recovery recommendations *A Texas AgriLife Extension Service / Sea Grant Extension Program Staff Paper* (pp. 60). College Station, Texas: Texas A&M University.

This report outlines a quantitative discussion of damages to the oyster industry from Hurricane Ike, as well as a qualitative discussion of the environmental benefits of oyster reefs in Galveston Bay. Hurricane Ike caused $38 million (2009$) in damages to the oyster industry in six different categories: buried or damaged oyster reefs (83.2%), vessels (4.3%), docks, piers and roads (4.9%), fuel systems (0.4%), plant and equipment (6.3%), and inventories (0.9%). The authors recommend restoring oyster populations due to their economic and environmental value. While the oyster industry only generates $10 million in annual amounts paid to fishermen, the authors feel that the non-market value of their biofiltration and reef habitat building properties means that using public funds (from $161 - $480 million to restore all oyster habitat) to rebuild public oyster grounds is worthwhile. The authors also recommend that oyster leaseholders explore options for Federal Crop Insurance Group Risk Plans to insure against catastrophic damage to oyster reefs.

This report proposes a business methodology called the ESR, or Ecosystem Services Review. The report begins by defining and discussing the four types of ecosystem services. The report goes on to identify which services have declined, improved, or had a mixed impact over the last 50 years. Businesses are dependent on ecosystems, and operational, regulatory, legal, reputational, market, product, and financing costs can be affected by the business use of ecosystem services. The proposed methodology consists of 5 steps: selecting the scope, indentifying priority ecosystem services, analyzing trends in priority services, identifying business risks and opportunities, and developing strategies. The approach strives to benefit the business conducting the review, while simultaneously benefiting upstream or downstream entities and ecosystems.


This issue brief is intended to provide introductory information to beneficiaries of watershed services and to forest landowners. Forested watersheds provide services that include water regulation and purification, erosion control, and fresh water supply. Converting forest area to urban area disrupts these services. It may be more cost effective to invest in green infrastructure--maintaining watersheds and the services they provide--than to pay for infrastructure to replace those services. The report discusses three payment options for internalizing costs and benefits associated with watershed services and urban development. Downstream beneficiaries can pay upstream land owners for protection of the forests. Also, businesses can pay land owners for assistance in meeting regulations. Finally, the government can pay landowners for the conservation of forests that provide public goods. An example of voluntary payment is the National Fund for Forest Financing, established by Energia Global, a Costa Rican hydropower company, and the Costa Rican government. The fund pays land owners $48 per hectare per year for conserving existing forests or reforesting their land, and this saves money on reservoir dredging (Perrot-Maitre and Davis 2001). Another example is New York City's spending of approximately $1.5 billion to maintain the ecosystem service of water filtration provided by the Catskills region. Building a water filtration plant would have cost from $8 billion to $10 billion (Kenny 2006).


Hardin's essay is a seminal work in the area of environmental economics. Hardin illustrates the fact that open access to resources will inevitably lead to an over-exploitation of the common resource for the individual's benefit. This has to do with public goods that are rivalrous (use of the good by one individual diminishes the good for the next individual), but non-excludable.

This article examines the relative spatial and temporal scales of ecosystem services with respect to both ecological and institutional scales. The paper discusses the four steps in the ecosystem services valuation framework: 1) specify the boundaries of the ecosystem to be valued, 2) assess the bio-physical services supplied by the ecosystem, 3) value the ecosystem service, and 4) aggregate the values. The authors stress the importance of valuing ecosystem services and their beneficiaries at the appropriate scales and propose a fifth step in the process: analysis of scales and stakeholders. Ecological scales are measured at the global, biome, landscape, ecosystem, plot and plant level and institutional scales are measured at the international, national, state/provincial, municipal, family and individual level. They note that ecosystems may provide services at overlapping scales (i.e. services generated at one ecological scale can provide benefits to people at multiple institutional scales and stakeholders at one institutional scale can receive ecosystem services generated at a range of ecological scales). The authors provide a case study of the De Wieden wetlands area in The Netherlands and apply these principles. The authors note the difficulty in measuring nature conservation services at the global scale and issues of spatial heterogeneity within services, particularly at the landscape and ecosystem level.


This article introduces a conceptual model of environmental accountability with a four-step, top-down approach: 1) National Policy, 2) Goals, 3) Measures of Ecosystem Services, and 4) Monitoring. This article focuses on the "measures" step and describes the development of ecosystem services (ES) valuation and human well-being indices that is underway at the EPA. The authors discuss the RESVI (Relative Valuation of Multiple Ecosystem Services Index) method for measuring ES. This method uses benefit transfer to estimate the value of an ES and scales that value based on public preferences, resulting in a measure of the directionality and magnitude of change in an ES given alternate management scenarios. The article discusses three case studies, one in MS and two in FL which utilized this method to estimate ES values for wetlands, forests and urban areas. The case study estimated wetland values at 27,222 ecodollars ($)/ha/yr, forests at 23,140 $/ha/yr and urban areas were valued at (-) 2010 $/ha/yr. The authors also introduce the Index of Human Well-Being (IWB), which is an effort currently underway at EPA to relate ecosystem services to human well-being at multiple scales. It is related to other measurements in the literature such as happiness, quality of life, and emergy indices. The article presents a very simple and transferable method of estimating ecosystem services, but risks an over or underestimation of benefits due to the errors inherently associated with benefit transfer.


This article provides a brief history on the origins of ecological economics. The author credits H. T. Odum as the first scientist to make the logical leap between ecology and economics, citing his work in the 1950s and 60s which attempted to give a dollar value to primary production in Corpus Christi Bay. Odum noted the impacts of humans on bay energetics as a change in metabolism (measured through diurnal oxygen curves) and realized that an economic assessment was required to quantify these human impacts.

The paper begins by briefly introducing ecosystem services, then goes on to discuss the policy tools available to governments to encourage private landowners to protect the ecosystem services provided by their land. They identify 10 different policy tools ranging from direct government regulations to incentives (payments) to public information. Each of these tools has a different level of coerciveness (restricts behavior), visibility (costs and benefits are detectable by providers and beneficiaries), directness (the entity which oversees the regulation or payment for the service also delivers the service), and automaticity (existing institutional structures used to carry out program). The authors compare each of the policy tools against these 5 criteria to identify the appropriate tool needed for different types of ecosystem goods. They group ecosystem goods into 5 categories based on their rivalry and excludability: public good, market good, common pool resource, toll or club good, and inefficient market good. The authors feel that utilizing these basic economic and policy criteria can lead to successful implementation of a payment for ecosystem services (PES) program. The authors provide recommendations of how to successfully implement a PES program using examples. These criteria would be useful for scoping a potential PES program.


King offers a critique of current ecosystem services valuation techniques. He believes that estimates derived from traditional economics regarding economic payoffs for just 1 or 2 wetland functions undervalues wetlands. He also believes that valuations from the non-economics literature such as embodied energy studies are not logical and will not hold up to critique. There are 3 ways that wetlands are currently valued: revealed willingness to pay (WTP), expressed WTP from a survey, and derived WTP (through avoidance costs). The author offers many reasons why wetland valuation is very difficult to measure because 1) most services are not traded in markets 2) people don’t know the true value of wetland functions so WTP is skewed 3) wetlands serve many functions and the cost of calculating these can be prohibitively expensive. The author believes that we should offer up numbers for wetland valuation, because most often governments treat a no-value estimate as a zero-value estimate, thus “any number is better than no number”. The author believes that many attempts to value wetlands from the non-economic literature are not logically sound. He feels the best measure of wetlands value is what governments have been wiling to pay to restore them. He offers a table with wetland restoration values from many different type of wetlands and believes that we should be willing to spend equal amounts to conserve wetlands as we have on projects to restore them.
King, P., & Symes, D. (2003). The potential loss in gross national product and gross state product from a failure to maintain California’s beaches: a report prepared for the California Department Of Boating and Waterways (pp. 43): San Francisco State University and the California Department of Boating and Waterways.

This study was undertaken in response to the OMB’s policy which limits Federal investment in California's beaches because of the belief that people who do not spend money at California's beaches will spend money in another US state, thus loss of CA beaches will result in no economic impact to the US economy. The study challenges these assumptions and quantifies the net loss to the Gross State Product (GSP) and Gross National Product (GNP) if California beaches no longer existed. The authors found that California would lose $5.5 billion annually in GSP and the US economy would lose $2.4 billion annually in GNP. This study does not allow for substitution (visitors would go to a beach in another state), so these figures represent a net loss to the economy. Because the study does not allow for substitution within the federal economy (analyzes net economic loss), the $2.4 billion figure seems to be an overestimate. The study found that out of state and foreign visitors represent a large amount of visitors to southern CA beaches.


This report represents one of the first attempts to broadly value ecosystem services in Galveston Bay, with prior work only analyzing the value of water quality improvements. The purpose of this report was to inform local policy-makers on the economic impacts of different management strategies. The report employs both market (commercial fish landings and tourist expenditure) and non-market (replacement cost method and embodied energy analysis) valuation techniques. The author reports a $5.77 billion non-use value for coastal wetlands, with each acre of wetlands around Galveston Bay worth $6000 (calculated using the average restoration cost from selected sites in Galveston Bay). The author discusses flat trends in revenue from commercial fishing and increasing trends in the value of recreational use of the bay. The report does not go far enough in its valuation of flood mitigation, water quality or habitat provision, as well as lacking any real value analysis (only discusses general trends) of the commercial and recreational benefits of the bay and how that relates to ecosystem services.


This annotated bibliography contains 108 annotations consisting of peer-reviewed journal articles, books and internet sources available in the area of ecosystem services and goods valuation for the estuarine environment. The valuation techniques reviewed are contingent valuation, hedonic pricing, production approach, travel cost, conjoint analysis, ranking method, replacement cost, avoided cost, market valuation and embodied energy.

This case study begins by outlining the economic "winners" and "losers" associated with the 1993 and 2008 Mississippi River floods. Due to widespread economic losses associated with damage to crops, infrastructure, transportation, etc. the 1993 and 2008 floods were two of the costliest natural disasters in US history (1993 flood cost $16 billion and the 2008 flood is estimated at $9 billion). Previous studies of the 1993 flood determined that flood damage was driven by land use changes and the associated loss or degradation of the regulating services provided by regional wetlands and riparian areas. The authors of this case study used landscape analysis to identify 1.9 million acres in the Mississippi floodplain that could be used for floodwater storage (drained wetlands and areas behind existing levees). The total net benefit from converting croplands within the Mississippi River's 100-year flood plain to functioning wetlands is $120.9 million, or $68 per acre. Additionally, the authors found that the number of bird species (an indicator of ecosystem health and biodiversity) would almost triple due to restoration of wetlands.


The article explains some methodologies for valuing ecosystem services and discusses flaws involved in considering man-made capital to be a substitute for natural capital. Four valuations of coasts and ocean services are given as examples: the Mediterranean Monk Seal in Greece, mangrove planting in coastal Vietnam, nutrient pollution in the Baltic drainage basin, and the Buccoo Reef Marine Park in Tobago. The article includes an appendix with data from different studies outlining ecosystem service being valued, valuation methodology used, and value obtained.


The purpose of the research discussed in this article was to find the marginal value of four prairie pothole wetlands and one wetland complex in the Prairie Pothole Region of North Dakota. These wetlands provide regulating and supporting services in the form of water purification, soil formation and retention, nutrient cycling and habitat. This study found the marginal value of each wetland, as opposed to finding the total or average value of the wetlands. The researchers took into account the fact that there are currently thousands of wetlands in the area, but as that number shrinks, the value of each remaining wetland would increase. The values were estimated from the owner, user, regional, and social perspective, with the social value representing the total marginal value of the wetland to society. The Nome, Buchanan, Alice, Tower City, and Rush Lake wetlands were estimated to have annual marginal values of $40, $27, $163, $69, and $67 per hectare, respectively. The article stresses the importance of comparing the value of a wetland to the best alternative use value in decision making.
This is a comprehensive work assessing the environmental status of Galveston Bay. This report characterizes the Bay in terms of water and sediment quality, key habitats, commercial and recreational resources, public health issues, physical forms and processes, and human interactions with the Bay. The report provides a status and trends type assessment of the Bay, outlining priority problem areas identified by the 1994 Galveston Bay Plan and analyzing if conditions have improved or declined over the period of analysis.

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The Galveston Bay Invasive Species Risk Assessment accumulated and assessed existing information describing the identity, characteristics, and impacts of exotic species invading natural ecosystems in the Lower Galveston Bay Watershed. A risk assessment was conducted to identify current and potential invasive species posing the greatest risk to the ecology and human uses of the Lower Galveston Bay Watershed.

This article discusses the basis for economic analysis of ecosystem services including common methodologies and complications. The report includes 11 case studies of coastal resource valuation and economic impact analysis in Florida. Topics covered include services provided by Florida saltwater marsh, the Everglades, and Indian River lagoon. One case study evaluates damage as a result of the Tampa Bay oil spill. Others look at the relationships between economies and tourism, pollution control, shrimp processing, the Spiny Lobster, water resources, and fishing.

The authors begin by discussing the complex and dynamic nature of ecosystems and the need to delineate ecosystem boundaries and relative scales when assessing their value. They stress the importance of recognizing the difference between substitutable and non-substitutable ecosystem services. When substitutes are available, traditional economic valuations are appropriate; however, in the case of critical, non-substitutable services, ecosystem-based valuations are more appropriate. In these cases, the valuation should assess the value of avoidance of catastrophic ecosystem change (collapse of a fishery, eutrophication of water body, overgrazing of grasslands) rather than valuing short-term human preferences (WTP or WTA). This article represents a good theoretical analysis of critical vs. non-critical and substitutable vs. non-substitutable ecosystem services.


This handbook discusses basic concepts of economic valuation and addresses the issues with applying economic valuation to natural damage assessment. Chapter 5 of this handbook is focused on indirect and direct measurement techniques for ecosystem goods and services. The indirect measurement techniques discussed are travel cost model, random utility models, and hedonic techniques. The direct technique discussed is contingent valuation. For each of these models or techniques the advantages, disadvantages, and data needs for each is discussed. This report is important because the recommendations of this panel led to the establishment of “best practices” for contingent valuation.


This paper provides a comprehensive review of the ecosystem services valuation (ESV) literature to date. The authors looked at 730 ESV papers over the last 50 years, outlining the progress in the field towards a more transdisciplinary approach. The paper outlines the use of ESV in the fields of cost-benefit analysis, "green" GDP, payment for ecosystem services, and natural resource damage assessment. The authors discuss the debate surrounding ESV including ethical issues associated with applying welfare economics to nature, political debate about how ESV should be used in policy-making decisions, and the methodological and technical debate around the accuracy of ESV methods. The authors argue that increasing use of trans-disciplinary approaches including use of ecosystem modeling, GIS, group valuation and participatory assessment should help overcome these obstacles.


The authors utilized benefit transfer, specifically point transfer, to estimate the ecosystem service value (ESV) of New Jersey's natural capital. They utilized 12 land use/land cover (LULC) types, overlaid with New Jersey's watershed delineation in GIS, to link valuation data with spatially explicit boundary data. The authors were able to tabulate per acre and total value estimates for each land cover type in New Jersey by utilizing the mean value for each LULC from the literature and applying it to the spatial data. The strength in this method is the recognition of spatial heterogeneity inherent in ecosystem services. The weakness is that it does not address the relative importance of one wetland or forest patch from another. There is also error associated with benefit transfer due to the quality of the primary studies and their applicability to the study area.

This article gives many good examples of the practical application of ecosystem services valuation. The author questions whether the cost of performing the studies is outweighed by the benefits of increased efficiency as a result of the studies. Several examples are given of the use of contingent valuation in determining the value of increased or more regular water flow downstream of dams. Results of several studies showed that people were willing to pay to increase water flow, helping fish and other wildlife, and increasing recreational opportunities. Some of these assessments were used in decisions to increase water levels in various parts of the country.


The authors utilized a continent valuation survey to derive the value of five ecosystem services along the Platte River. They found that households were willing to pay, on average, $252/yr for additional ecosystem services. This amount was more than enough to pay for the conservation easement payment to farmers or leasing of water rights that would achieve improvements in flow and habitat in the Platte River.


This article focuses on a framework for increasing biodiversity in non-industrial private forests (NIPF) in Florida. The purpose of the article is to identify forest practices that promote biodiversity in the region, assess the effect of these forest practices on the production value of the land, and estimate landowners' willingness to accept (WTA) for adopting these practices. First, the article outlines forest practices that can lead to the largest increase in biodiversity in the region as 1) uneven-aged forest management, 2) prescribed burning, 3) delaying timber harvesting, and 4) increasing stream size management zone (SMZ) width. It was determined that uneven-aged forest management was not feasible for implementation and so was replaced in the study by invasive species control, a practice that would also lead to an increase in biodiversity. The Land Expectation Value could fall from approximately $1980 per ha to $83 per ha with a more intense adoption of these practices, but this value varies greatly depending on cost and frequency of prescribed burning and invasive species control and the percent of land area occupied by a stream buffer zone. Landowners' WTA for higher restrictions on these practices (200 foot SMZ, timber harvest after 50 years, prescribed burning every 2-3 years, and invasive species control every 2-4 years) was determined through contingent valuation to be $87.13 per ha per year. Landowners indicated that they would be willing to pay some of the costs of implementing the proposed practices at a lower level of restriction because they value the benefits these practices can have on wildlife management and timber production.

The screening criteria used by the Nature Conservancy to assess the need for an ecosystem service approach in conservation projects including expected delivery of services and conservation, and legal, institutional, social and economic conditions.


Chapter 2 of the MEA defines ecosystems and the benefits that humans derive from them. The authors stress the need for a defined boundary of a given ecosystem, for instance, a watershed or soil type, or larger biomes. This chapter defines the four types of ecosystem services: regulating, provisioning, cultural and supporting, and list and describe the many benefits that people obtain from those services. The authors promote systematic assessment of ecosystem conditions and their services by quantitative and qualitative methods so that ecosystem variability, resilience and thresholds can be ascertained. This is important when decision makers must allocate scarce resources. This chapter provides the backbone of the ecosystem services framework.


Chapter 6 of the MEA outlines the various definitions of value in relation to ecosystem services and the many market and non-market valuation methodologies used to evaluate them. The authors delineate use and non-use values under the anthropocentric, or utilitarian, concept of ecosystem value and present the many socio-cultural values of ecosystems, as well. This chapter creates a framework for assessing total economic value by aggregating use, non-use (existence), and option values. The authors discuss how to put ecosystem services valuation (ESV) into practice as a tool for evaluation of trade-offs between alternative management decisions. This chapter is useful at defining the broad concepts underlying ESV but does not undertake any specific valuations.

MIMES. (2011). Multi-scale integrated models of ecosystem services website.

MIMES is a suite of models that enables understanding of the contributions of ecosystem services by quantifying the effects of varying environmental conditions derived from land use change. MIMES evaluates land use changes and subsequent effects on ecosystem services on global, regional and local levels.

This report was a culmination of a project with the purpose of creating an Ecosystem-Based Management Plan for the Nueces Estuary in Corpus Christi, Texas. The boundaries for the study were determined utilizing a combination of hydrologic, ecoregional and socio-economic units. The study determined the dominant habitats within the boundary and identified the ecosystem services provided by each habitat. Through an intensive data gathering and stakeholder process, the authors determined which habitats provided the most ecosystem services and mapped them. This report also identified current and future threats to habitats and their associated ecosystem services. This report will be used to help direct land use activities in the area.


In this chapter the authors review the development of the conceptual framework for ecosystems and the benefits they provide to human society. They conclude that despite 130 years of increasing knowledge of ecosystem services most people are ignorant of the relationship between ecosystems and the economy.


The Scolel Té Plan Vivo program allows land owners to receive payments for ecosystem services provided by their forests and agriculture practices. Specific benefits provided by sustainable land management practices are carbon sequestration, biodiversity, and water and soil quality. In 2007, payments of $311,495 were made for the carbon sequestration service. Funding comes from the voluntary carbon market. The program provides both social and environmental benefits because it internalizes the benefits from carbon sequestration for landowners.


This paper analyzes the tradeoffs between ecosystem services and biodiversity, utilizing the InVESt modeling tool to analyze three different land use scenarios in the Willamette Basin, Oregon. The model analyzed 3 different development scenarios (as crafted by stakeholders): Conservation (placed greater emphasis on protection and restoration of ecosystems), Development (represents a loosening of current development policies, market-driven) and Plan Trend (scenario under plausible future policy recommendations). Major conclusions: scenarios that enhance biodiversity also enhance ecosystem services, scenarios under the Development schema led to loss of biodiversity and ecosystem services unless a payment for ecosystem services (PES) system was in place. When PES was in place the Development scenario led to similar outcomes as the Conservation scenario. Additionally, if carbon sequestration values are calculated using current carbon markets, the Conservation scenario provides the greatest market value for the landscape compared to the 2 other development scenarios (this does not include payments for other ecosystem services such as water quality or storm mitigation).

The purpose of this report was to analyze the future for environmental accounting in the US. The panel recommended that the national income and product accounts be expanded to include, nonmarket resources such as natural resources, as they are of considerable importance to the national economy. The panel recommended developing a comprehensive set of both market and nonmarket accounts for environmental capital, which take into account nonmarket service flows.


This study utilized satellite imagery, field data and UFORE modeling to analyze the ecosystem services provided by the forests in the Houston region. There were 332 field plots used to provide data for the model. The study attempted to quantify the value of forest ecosystem services such as air pollution removal, carbon storage, energy saving and tree replacement value. This study estimated 663 million trees in the study area, with a replacement value of $205 billion. The annual environmental benefits were $456 million and the carbon storage value was $721 million. The study found that 60% of the environmental benefits provided by Houston forests are from trees 5 inches greater and diameter. These trees comprise only 30% of all trees in the region. The protection of large trees will protect future benefits. This study does not address double counting of ecosystem services.


The purpose of this report was to outline a framework for integrating ecosystem services into environmental decision-making. The focus of this report was on aquatic ecosystems and their associated upland terrestrial ecosystems. Because aquatic ecosystem contribute to the health of many economic sectors, protecting these resources is vital to future economic growth. The committee assessed different valuation techniques including both use and non-use valuation. The committee also analyzed the relationship between ecosystem services and ecosystem functions, research requirements for ecosystem service assessment, error and bias in these measurements, and lessons learned from ecosystem services assessment case studies. The committee identified three major reasons for an inability to generate reasonable estimates of ecosystem services as: 1) insufficient knowledge to quantify ecosystem services 2) inability of economic methods to estimate value and 3) lack of integration of ecological and economic analysis.

The report summarizes several examples of successful policy use in the protection of ecosystem services in watershed areas throughout the country. The initiatives are presented as successful based on three stages of success: recognition of need for change, shift towards ecosystem services-oriented action, and resulting positive impacts on ecosystem services flow. Methods of cost internalization included taxes and fees on citizens using water and mitigation banking. "Forests to Faucets" is a Santa Fe program which has diminished the 20% annual chance of an estimated $22 million forest fire through forest management funded partially by water usage taxing. Total funding needed for the program is estimated at $4.3 million. "Clean Water Services" is a resource management agency in Oregon estimated to have gained net benefits of $54 to $144 million by avoiding the necessity for a water cooling system through the sales of water quality permits. Many of the other ecosystem preservation and conservation programs mentioned use similar policies of taxes, fees, mitigation banking, or permits, but do not have qualitative results.

Oden, M., Butler, K., & Paterson, R. (2003). Preserving Texas coastal assets: economic and natural resource evaluation of erosion control projects under the Coastal Erosion Planning and Response Act (pp. 90). Austin, Texas: The University of Texas and the Texas General Land Office.

This report summarizes the economic costs and benefits of the Texas Erosion Control Projects under the Coastal Erosion Planning and Response Act (CEPRA). The report notes five basic ways in which erosion control has tangible economic benefits: 1) reduced losses to public property from storm damage and erosion, 2) preserved value of private properties in proximity to the project areas, 3) generation of additional property tax revenue, 4) sustained visitation and related tourist spending the affected area, and 5) generation of additional user fees from recreational use of the coastal asset. The report evaluated 13 CEPRA projects and found a total net benefit of the projects of $127.8 million (2009$). For every dollar invested in these projects $16 dollars will be generated in benefits over the life of the project. Projects ranged in the length of their project life. The authors used a discount rate of 7%.


This study utilized a mail survey to ascertain landowner perceptions of rangeland ecological services and their willingness to participate in land management programs to protect those services. The study took place in the Edwards Aquifer area of Texas. The authors concluded that respondents were more willing to participate in voluntary, short-term (5-10 years) cost-sharing land management programs. Landowners were much more interested in programs which conserved water than those which increased carbon sequestration and they were not in favor of programs that increased woody cover vs. those that conserved native grassland ecosystems. The study gives insight into what type of land management programs private landowners in Texas would be willing to accept.

The author begins by summarizing the seminal paper by Hardin, *The Tragedy of the Commons*, and the effect it has had on environmental economic theory since its publication in 1968. Hardin’s theory describes the problems with common pool resources (CPRs), or non-exclusive resources, whose exploitation by one user reduces remaining resources available to another user. The authors of this paper question the assumption behind Hardin’s theory, which is that users are “selfish, norm-free, and maximizers of short-run results.” The authors describe four different type of users of a common pool resource: 1) self-interested users or “free-riders”, 2) those unwilling to cooperate unless they are assured of protection against free-riders, 3) those willing to initiate reciprocal cooperation amongst others, and 4) genuine altruists. The authors describe examples from local CPRs where people self-organized to protect a resource. The authors go on to discuss the challenges of global common pool resources including: scaling up of the problem (over 6 billion people on the planet), challenges due to cultural diversity, the complexity associated with interlinked resources, accelerating rates of change, and unanimous agreement required by collective choice. The author believes that protecting institutional diversity will retain the diversity of CPR solutions that we will need to cope with future CPR issues.


The authors used a mixed logit random utility maximization model, combined with a trip frequency model to estimate welfare loss value on a per trip basis and for a loss-to-trip ratio for the Padre Island National Seashore as well as various other popular beaches along the Texas Gulf Coast. The mean per-trip loss for closure of all Padre beaches is $20 and the loss-to-trip ratio is $180. The aggregate loss for an entire season is $73 million, (in 2008 dollars). This paper also presents numbers for Sabine Pass, Galveston, Freeport, Port Lavaca, and Corpus. The paper outlines the high substitutability amongst beaches within the same region. The Galveston beaches were the most visited with a $55.63 loss-to-trip value at East Beach ($4.32 per trip), a $68 loss-to-trip for all Galveston beaches combined and an aggregated $174 million for the loss of all beaches in the Galveston region for an entire season.


The President’s Council of Advisors on Science and Technology (PCAST) submitted a report to the president outlining recommendations for protecting environmental capital and ecosystem services. The report recognized that environmental capital has been degraded by human activities and increasing population and development will only put more pressure on these resources. They discuss the issue of common pool resources and the fact that environmental degradation is an externality spread across society instead of internalized by polluters. The panel feels there are two ways in which government can deal with these challenges: incentives for private actors to change their behavior and direct action by governments to protect ecosystems on government lands. They had 6 recommendations for protection of environmental capital and ecosystem services: ecosystem services trends assessment, development of an inter-governmental science and policy platform, prioritization of ecosystem conservation programs based on cost efficiency, improvement of valuation capabilities within federal agencies that deal with the environment, identification of data gaps in biodiversity inventories and clarification of priorities and agency roles for filling these gaps, and establishment of an ecoinformatics-based Open Resources and Machine Accessibility initiative to integrate the current ES knowledge base.

This report categorizes methods of creating a market for ecosystem services as "self organized private deals," "trading schemes" and "public payment schemes." These three methods of value capture, or at least partial value capture, of ecosystem services into market transactions are exemplified by nine case studies. The first is located in northern France where Vittel, a bottled water company, found it was more economical to invest in ecosystem services to provide purified water than to move locations or build water purification facilities. This was an example of a self-organized private deal but was also partially funded by outside institutions. A similar program exists in Costa Rica. An energy company pays landowners (via a government agency) to reforest their property or to maintain forests in order to increase flow for creating hydroelectric power. In Colombia, an association of irrigators who need downstream water pay a governmental program, the Cauca Valley Corporation (a river authority), to purchase land and pay owners for certain upstream land management practices. In many river areas in the United States companies are able to trade nutrient credits in order to meet standards, and in Australia credits are traded for desalinization of waters. In New York, the decision to protect ecosystem services providing fresh water, instead of building a water treatment plant, was made due to the valuation of ecosystem services. In cases in Colombia and Parana, Brazil, taxes were also placed on the use of ecosystem services. In farmlands in the United States, landowners may be compensated for protection of the environmental services on their lands. At the end of the report, data is given on water production in many areas of the Gulf of Mexico.


The authors begin with a review of the many issues associated with commodification of ecosystem services for the purpose of protecting ecosystems. The authors believe that commodification of nature has “decouple[d] [ecosystem] function from service” so that people do not recognize the full value of the ecosystem, but rather just the monetary value (e.g. carbon storage value) of the ecosystem that can be captured by the neoliberal economic perspective. The authors believe this is a failure of the ecosystem services framework to give adequate attention to biotic components of the ecosystem. They believe that the work of Odum and Odum, which focused on energy, and utilized the language of ecosystems rather than the language of economics, is the only way to appropriately measure ecosystem value. Using energy instead of dollars as a measure of value would result in valuing the regular economy in terms of the environment. This paper is useful because it outlines the problems with commodification of ecosystem function. The authors emphasize shifting valuation from the the ecosystem service (product) to the ecosystem worker (producer), thus properly valuing biodiversity in the ES scheme. Because of the difficulty and expense involved in such a measurement, it seems unlikely that it will be adopted.


The article provides an overview of the contingent valuation method and the debate surrounding it. The method involves use of sample surveys to elicit willingness of respondents to pay for hypothetical projects. The values revealed by respondents are contingent upon the constructed or simulated market presented in the survey. The method is being debated by factions within the federal government, economists and lawyers representing business and environmental groups. At issue is whether environmental regulations should sanction use of contingent valuation in estimating the damage done by spills of hazardous substances. More broadly the debate addresses what economists have to say about the values people place on public and private goods and services.

This research tested a method for combining two models for ecosystem services valuation to find the best solution for sustainability in the Goulburn Broken Catchment in Victoria, Australia. The report first describes the method used for valuation in this study, a combination of multi-criteria evaluation and a citizens' jury. The goal was to find a balance between ecosystem services, the economy of the region, and the social value of the region. The biggest issue at hand was the impact of tourism on ecosystem services, and the need for ecosystem services to sustain tourism. Through a jury of stakeholders, it was determined that finding a balance between the three would lead to benefits of $9 million to $57.3 million with costs of $18.3 million. Maintaining the current situation would lead to benefits of $5.5 to $6.5 million with costs of $2.5 to $3.5 million.


This article discusses the importance and potential use of ecosystem services valuation in California, focusing specifically on beaches and estuaries. The report discusses the need in many Californian programs and governing bodies for a non-market valuation in the coastal zone. The report gives a compilation of values obtained from other studies for ecosystem services in estuary and coastal regions.


This essay reviews the economics literature on market failure, particularly as it relates to non-rival, non-exclusive goods and services and the role of government. He uses game theory to evaluate the potential for stable, efficient solutions to allocation. The essay concludes that nonexclusive, non-rival sectors are less vulnerable to economic collapse than previously thought. Allocation issues may be resolved by strategies between privatization and government regulation.


The historic sediment accretion rate in West Galveston Bay is 0.20 cm y$^{-1}$ and relative sea-level rise (the rate of rise of the water depth due to the combined effects of eustatic rise and subsidence) is 0.65 cm y$^{-1}$. The researchers found that in West Galveston Bay this is the major reason for erosion of salt marsh, specifically in marshes where the wave action is less than 0.17 m. The authors recommend that restoration projects in this area consider ways to increase sediment supply, and not focus on attenuating wave action. This study highlights the fact that wetland loss can be due to a variety of reasons, which may be very location specific.

This workshop was conducted by EPA with the goal of defining indicators of ecosystem services for streams. The major stream attributes that were posited to be indicators were quantity and timing of water, physical, chemical and biological integrity of the stream, and the aesthetic or landscape value of the stream. The participants created a matrix which outlined the ecosystem services provided to each user group (i.e. agriculture, industry, municipal, education, etc.) and the biophysical indicator that was associated with that ecosystem service. The advantage of the matrix is that it could be applied to any stream, but the disadvantage is that there was no ranking of benefits associated with streams.


The study assessed the benefits of different wetland restoration techniques for fishery resources. It examined construction costs, habitat complexity and support of fisheries for five marsh restoration projects in Galveston Bay. These projects used bottom sediments or upland soil to construct intertidal areas where smooth cordgrass was planted. Results of restoration included higher populations of fishery species than pre-restoration conditions. The authors concluded that restoration projects should maximize the area of marsh vegetation and create a high degree of water-marsh interspersion to provide the best benefit to cost returns.


This article reviews the basics of ecosystem services and discusses the obstacles of implementation of markets for ecosystem services: understanding of service provision and pathways, institutional capacity, and challenges in establishing private markets for public goods. The author goes on to discuss payments as an effective way to utilize government funds to spur private markets. He discusses each of the criticisms put forth against payments and discusses the disadvantages and advantages of a payment system vs. taxes or regulation, citing examples from water quality markets in Australia.


Samuelson was the first economist to define pure public goods or “collective consumption goods.” Public goods are non-rival and non-excludable. Samuelson defined non-rivalry as goods “which all enjoy in common in the sense that each individual's consumption of such a good leads to no subtractions from any other individual's consumption of that good...” Because public goods are non-rival and non-excludable, the demand function for a public good is summed vertically, that is, taking each person’s demand for that good and summing them to get an aggregate demand.

This report focuses on the application of ecosystem services valuation studies, outlining the four major uses as advocacy, decision making, damage assessment, and sustainable financing. The report gives examples of the practical application of ecosystem services valuation studies on an Egyptian desert, Aral Sea wetlands, South African catchments, climate change in the UK, marine protected areas in the Netherlands, forests in Costa Rica, and the Exxon Valdez oil spill. These examples are all summaries from a longer article, Influential Case Studies, by the same authors. The report gives helpful figures like the duration, cost, time and effort required to conduct an ecosystem services assessment at many different scales and locations.


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This report is a revised version of the USFWS report on this topic. 2006 Survey found that 6.0 million Texas residents and nonresidents 16 years old and older fished, hunted, or wildlife watched in Texas. Of the total number of participants, 2.5 million fished, 1.1 million hunted, and the 4.2 million participated in wildlife - watching activities, which include observing, feeding, and photographing wildlife. The sum of anglers, hunters, and wildlife watchers exceeds the total number of participants in wildlife-related recreation because many individuals engaged in more than one wildlife-related activity. In 2006, state residents and nonresidents spent $8.91 billion on wildlife recreation (retail sales) in Texas. This created $4.67 billion in salaries and wages, and supported 139,404 jobs for a total economic effect of $15.8 billion.
This article examines the use of a baywide nutrient trading program and the potential benefits for farmers in the watershed. In this scheme entities that can reduce nutrients (such as nitrogen) below target levels could sell their surplus reductions as nutrient credits to entities that have higher nutrient reduction costs. The authors see this as an opportunity for farmers, who have a lower nutrient reduction costs than an entity such as a waste water treatment plant, to receive monetary benefits from nutrient reduction. Practices such as conservation tillage, nutrient management and vegetated buffers are effective and efficient means of nutrient reduction that can be implemented by farmers. Existing government conservation cost-share programs could cover many of the startup costs of this program.

Tampa-Bay-Estuary-Program. (2011). Tampa Bay ecosystem services demonstration project website
A website describing the ecosystem services assessment project in Tampa Bay including information such as ecosystem services schematics, a production matrix and land use/land cover maps. This project is being used as a case study by the EPA’s Ecosystem Services Research Program.


The purpose of this TEEB (The Economics of Ecosystems and Biodiversity) report is to encourage incorporation of the value of ecosystem services into government policy and business practices. The report discusses the importance of capturing value in decision-making to take into account full costs and benefits. The report is focused on forest ecosystem services, services in urban areas, and ecosystem services in mining areas. Various values are given for ecosystem services in many systems, including coral reefs in Hawaii, tropical forests, parks in cities, and mining zones. Several examples are given of the implementation of ecosystem services valuation in policy and business practices. These include changes in business practices, credits or payments issued for the protection or restoration of ecosystems providing services, fees or taxes placed on the usage of ecosystem services, and offset credit banking.


This is a webpage describing the InVEST model. The model and user's manual are available for download. InVEST requires the user to create different spatial scenarios for land use, often created using stakeholder input. InVEST can then estimate how the amount, delivery, and location of ecosystem services are likely to change based on the scenario. InVEST utilizes ArcGIS to create map outputs at local, regional or global scales so that each scenario can be represented spatially. InVEST looks at flows of ecosystem services across a landscape. Depending on the availability of data, InVEST can be used to simply identify patterns of ecosystem service change, or if there is a lot of data about an area, it can create actual ecosystem service valuations.

This report presents results of a large survey of anglers in Texas. The data presented in this study implies both changing rates of fishing participation and a lack of growth in the current angling population. One of the most significant findings of this study is a precipitous decline in the number of license sales over the previous three year period. This decline is likely due to the changing demographics of the Texas population, as white, middle-class anglers are aging out of the angling population and the increasing Hispanic population has been less likely to engage in fishing. Although the angling population is aging, as expected from the aging of the population statewide, there was a lack of any noticeable change in the racial and ethnic composition of the current clientele from previous study years. The primary Texas sport fish continue to be black bass and red drum for freshwater anglers and saltwater anglers, respectively. Angler satisfaction with both fresh and saltwater fishing in Texas remains high, with a majority of each angler group reporting they are very or extremely satisfied with fishing in Texas.


The purpose of this research unit is to improve urban forest management, planning and design. The UFORE model was designed to measure vegetation structure, species composition and distribution, and number of trees and they effect that all these factors have on ecosystem services. UFORE utilizes aerial and ground-based assessments to provide data for the model. The UFORE model is accessible through the i-Tree software. This tool can be useful for measuring ecosystem services (such as pollutant removal & carbon storage) provided by trees.


This 2006 survey found that 6 million Texas residents and nonresidents 16 years old and older fished, hunted, or wildlife watched in Texas. Of the total number of participants, 2.5 million fished, 1.1 million hunted, and the 4.2 million participated in wildlife - watching activities, which include observing, feeding, and photographing wildlife. The sum of anglers, hunters, and wildlife watchers exceeds the total number of participants in wildlife - related recreation because many individuals engaged in more than one wildlife-related activity. In 2006, state residents and nonresidents spent $9.2 billion on wildlife recreation in Texas. Of that total, trip-related expenditures were $2.9 billion and equipment purchases totaled $4.7 billion. The remaining $1.6 billion was spent on licenses, contributions, land ownership and leasing, and other items.

This report focuses on the application of ecosystem services (ES) valuation studies, outlining the four major uses as advocacy, decision-making, damage assessment, and sustainable financing. The report gives examples of the practical application of ES valuation studies on an Egyptian desert, Aral Sea wetlands, South African catchments, climate change in the UK, marine protected areas in the Netherlands, forests in Costa Rica, and the Exxon Valdez oil spill. The report gives helpful figures like the duration, cost, time and effort required to conduct an ecosystem services assessment at many different scales and locations.


The BSR report was conducted with the understanding that ecosystem services will become increasingly important for corporate performance metrics in the future. This study compared 7 different ecosystem services tools using a hypothetical housing development project in Arizona’s San Pedro Watershed. Water provisioning, carbon sequestration, cultural services and biodiversity were the four parameters that were used in the comparative assessment. The report contains a very helpful table which listed the time, cost, and level of expertise required for each tool and another table which helps the user decide which tool to use based on where they are in the decision-making process: Screening, Scoping, Assessment, or Development of a Management Plan. Some of the major conclusions of this report were that side-by-side comparison of tools is difficult, because of the wide range of analytical tools. Additionally, ecosystem service tools need to be adapted to corporate accounting and processes in order to be useful in the corporate context.


This purpose of this workshop/report was to engage the corporate community in the conversation about ecosystem services. This report discusses some of the possible motivations behind corporate adoption of ecosystem services assessment including new ways to create value, differentiation among competitors, realization of new revenue streams, saving on costs, incorporation into risk mitigation practices, and more. The report summarizes the current status of ecosystem services valuation tools and their applicability to business (aka when and how to use them). The report concludes with a corporate needs assessment for tool development. This report contains a very useful table summarizing the capabilities of the 7 prominent ecosystem services tools.


This report calculated the economic impact of 80 Texas state parks on their host counties. A total of 11,709 visitors to 75 state parks were interviewed in 2002 and 2004. The research team collected data on expenditures of visitors and their group and reported this data for a total of 44,799 visitors. Using IMPLAN software, direct expenditures by visitors were inputted into IMPLAN software to calculate the total host county economic activity from sales transactions, household income and employment. Aggregating in-county and out-of-county expenditures (expenditures by TPWD in Austin) provided a
The total economic activity of state parks is estimated at $793 million in sales and $456 million in impact on residents’ income. Economic activity related to state parks accounted for an estimated 11,928 jobs.


This report is a scoping study to provide businesses with an understanding of the background of ecosystem services and the current state of affairs in ES valuation (including data sources and tools available), discuss how ES valuation is relevant to business, and explore the needs and gaps in current ecosystem services valuation and a way forward for businesses. The report contains ten case studies of the application of ecosystem services valuation by business.


Whittington et al. attempted to estimate the economic value of Galveston Bay utilizing both use and non-use valuation techniques. The authors used contingent valuation methods via a mail-in survey to ascertain non-use values such as aesthetics and “quality of life”. Respondents from the survey were willing to pay $5 per month for 5 years (in 1984 dollars) to clean up the Bay. The authors calculated an aggregated non-use value of $100-150 million per year from the WTP survey for water quality improvements to the bay. Additionally, they calculated annual use values of $75-150 million (utilizing benefit transfer methods) from recreational fishing, $25-50 million for boating, and $15-50 million for other uses such as hiking, picnicking, camping hunting, swimming and bird-watching. Annual commercial fishing values were $1-2 million (using net revenue analysis). The authors warn against summation of these use and non-use estimates as it would result in double counting. There were discrepancies in values from respondents in the mail-in versus personal interview surveys (in-person interviews resulted in much higher WTP values). The uncertainly introduced by this discrepancy prompted the authors to use the more conservative values associated with the mail-in surveys in their value calculations.


This article introduces and summarizes articles about the state-of-the-art and science of environmental benefit transfer (BT). The need for an issue of this kind became apparent after the conclusion of workshops by EPA and Environment Canada where 5 major questions were raised: 1) What is role of economic theory in guiding BT, 2) how can the social and natural sciences contribute to BT, 3) what are the sources of error in BT, 4) what are the effects of temporal, demographic, methodological and spatial differences on BT, and 5) how does the quality and availability of original studies affect the use of BT? This issue compiles the knowledge of 32 experts in benefit transfer focusing on these 5 major issues. The articles within this issue could be used as a way to screen BT studies to ensure valid use of benefit transfer.

This article discussed the efforts of creating coastal management zones that are ecological rather than political in nature. The authors feel that the ecosystem approach for coastal management is a necessary step in the proper valuation and restoration of ecosystems. The authors describe the 3 major geographic units, 5 major coastal hydrologic units, and the 8 coastal/terrestrial ecological regions along the Gulf of Mexico. The authors feel that no matter which measurement approach is used the cross-cutting management issues are as follows: controls of primary production and water fertility, energetic pulsing, vulnerabilities due to climate change, coastal wetlands restoration, sustainable economic development of the coastal zone and integrated coastal zone management (ICZM). ICZM is a process by which natural processes, climate & landscape, and potential land use changes are integrated into the land use planning process with an eye on balancing ecological, social and economic factors. This article does not offer a solution for integrating or overlaying the different management units.


This study examined the value of freshwater inflow for the regional economy around the southern tip of Texas. In response to a willingness-to-pay (WTP) survey, people engaged in resource-related recreation were willing to donate to a trust for protection of freshwater inflow to the coastal region. The results suggested that about $10 million could be obtained for protection of water for the estuary.


Two methods were used to assign value to the ecology dependent on freshwater inflow from the Guadalupe River to San Antonio Bay. In response to a survey assessing willingness to pay (WTP) for outdoor recreation opportunities in the San Antonio Bay area, respondents answered that they would pay, on average, $124 per person to protect the estuary by protecting freshwater inflows. The second approach used travel costs of Texas residents who visited the coastal region. The survey indicated that travelers would be willing to pay about $40 more per trip to maintain the region’s natural and recreational attractions.


The authors conducted a willingness to pay (WTP) survey of 418 Rio Grande recreationists regarding their willingness to pay to protect environmental flows in the Rio Grande River in Texas. The authors found a mean value for protection of freshwater inflow of $129 per person in the form of a one-time donation to a water trust. The aggregate value across the target population (Rio Grande recreationists & conservationists) was $9.9 million.