

Valuation of Biodiversity

Title: Approaches to Valuing the Hidden Hydrological Services of Wetland Ecosystems

Author: Acharya, G.

Source: Ecological Economics, October 35(1): 2000, pages 63-74.

Abstract: This paper investigates the role of the production function approach in capturing the value of hydrological services of wetland ecosystems. Hydrological research in the Hadejia-Nguru wetlands in northern Nigeria suggests that the major role of the wet season inundation of the wetlands is in recharging the underlying aquifers. This paper shows that the hydrological services extend beyond direct use values, and have a significant economic value associated with them. Whereas the direct benefits provided by the wetlands, such as floodplain agriculture, fishing and forestry, have previously been assessed, this paper synthesizes the results of two approaches to capture the value of indirect benefits derived from the role of the wetlands in replenishing and maintaining groundwater resources within the wetland area.

Title: The Value of Wetlands: Importance of Scale and Landscape Setting

Author: Mitsch, W. J., Gosselink, J. G

Source: Ecological Economics, October - 35(1): 2000, pages 25-33

Abstract: Wetlands have value because their functions have proved to be useful to humans. The unit value for some wetlands also increases with human development (agriculture and urban) because of increased use and/or increased scarcity. Yet, paradoxically, its functions can easily be overwhelmed in areas of heavy human development, thus lessening those values. Thus wetlands appear to work best in the landscape as spatially distributed systems. Also, the value is partially dependent on where they are found in the landscape, e.g., the degree to which a wetland is open to hydrologic and biological fluxes with other systems, including urban and agricultural landscapes. A paradox of assigning values to wetlands and other ecosystems is that it can argue for the replacement of one system with another if a landscape view is not taken. Estimates of percent of landscape for various functions, e.g. water quality or flood control, are presented. It is suggested that a range of 3–7% of temperate-zone watersheds should be in wetlands to provide adequate flood control and water quality values for the landscape.

Author Keywords: Wetland value; Marginal value; Watershed management; Landscape ecology; Wetland economics

Title: Ecosystems, contingent valuation and ethics: The case of wetland recreation

Author: Spash, C.

Source: Ecological Economics, 34(2), 2000, pages 195-215

Abstract: This paper addresses a current issue in environmental valuation, namely, the extent to which environmental preferences depart from the usual economic paradigm to incorporate some lexicographic elements. After a theoretical discussion the paper reviews attempts to explore this question empirically by supplementing contingent valuation analyses with an exploration of the motives behind willingness-to-pay responses, including zero bids and refusals to answer. This is followed by the presentation of new

evidence investigating respondents willingness to pay for the creation of a wetland taken from 713 personal interviews of the British public.

Author Keywords: Contingent valuation method; Environmental ethics; Intrinsic value; Lexicographic preferences; Rights; Wetland ecosystems

Title: The Benefits and Costs of Riparian Analysis Habitat Preservation: A Willingness to Accept/Willingness to Pay Contingent Valuation Approach

Author: Jean-Pierre Amigues, Catherine Boulatoff (Broadhead), Brigitte Desaignes, Caroline Gauthier and John E. Keith

Source: Ecological Economics, November 43(1): 2002, pages 17-31

Abstract: The Contingent Valuation Method (CVM) was used to obtain the willingness to pay (WTP) of households in the contiguous area of the Garonne River near Toulouse, France, and the willingness to accept (WTA) of households that currently own land on the banks of the river to provide a strip of riparian land for habitat preservation. Results for the WTP study indicated a relatively large difference in WTP between open and closed ended responses. When corrected for the substantial number of 0 observations, the WTP was reduced by about half. The WTA results were constrained by relatively few positive responses. However, the value given by farmers who indicated a positive WTA appears consistent with revenues generated from crops. Moreover, many farmers who were already providing habitat preservation indicated a zero minimum WTA. Although the small number of WTA responses severely limits the ability to draw definitive conclusions, a comparison of the derived benefits (WTP) and costs (WTA) was made, which appeared to suggest the possibility of a favorable a benefit/cost ratio.

Title: The Economic Valuation of Saltwater Marsh Supporting Marine Recreational Fishing in the Southeastern United States

Author: Bell, F. W.

Source: Ecological Economics, June 21(3): 1997, pages 243-54.

Abstract: This paper is concerned with placing an economic value on the contribution of wetlands in supporting recreational fishing in the southeastern United States. A production function first links the recreational catch to angler fishing effort and wetlands. The parameters of the recreational fisheries production function are estimated using cross-sectional data by states. To simplify the mathematics, the estimated elasticities are substituted into a Cobb-Douglas production function. For simplicity, a linear demand curve for recreational fishing is postulated which shifts when there is an increase or decrease in the catch (success rate). Therefore, incremental changes in wetlands will via the production function provide incremental changes in the catch which will in turn shift the recreational demand curve, thereby increasing or decreasing consumer surplus. Using a discount rate of 8.125%, the perpetual flow of consumer surplus per incremental acre of wetlands has an estimated asset value of \$6,471 and \$981 on the East and West Coast of Florida respectively in 1984 dollars. If commercial fisheries and other economically useful functions of wetlands are added to recreational fisheries, it may be more efficient for the State of Florida to acquire more coastal land for preservation from development.

Author Keywords: Wetlands; Production function; Recreational fisheries; Consumer surplus; Asset value of wetlands; Preservation versus development

Title: Valuing Urban Wetlands: A Property Price Approach

Author: Mahan, B. L., S. Polasky, R. M. Adams

Source: Land Economics, February - 76(1): 2000, pages 100-113

Abstract: This study estimates the value of wetland amenities in the Portland, Oregon, metropolitan area using the hedonic property price model. Residential housing and wetland data are used to relate the sales price of a property to structural characteristics, neighborhood attributes, and amenities of wetlands and other environmental characteristics. Measures of interest are distance to and size of wetlands, including distance to four different wetland types; open water, emergent vegetation, scrub-shrub, and forested. Other environmental variables include proximity to parks, lakes, streams, and rivers. Results indicate that wetlands influence the value of residential property and that wetlands influence property values differently than other amenities. Increasing the size of the nearest wetland to a residence by one acre increased the residence's value by \$24. Similarly, reducing the distance to the nearest wetland by 1,000 feet increased the value by \$436. Home values were not influenced by wetland type.

Title: The ecological basis for economic value of seafood production supported by mangrove ecosystem

Author: Ronnback, P.

Source: Ecological Economics, 29(2):1999, pages 235-252.

Abstract: The undervaluation of natural products and ecological services generated by mangrove ecosystems is a major driving force behind the conversion of this system into alternative uses. This trend of undervaluation is partly due to the difficulty involved in placing a monetary value on all relevant factors, but lack of ecological knowledge and a holistic approach among those performing the evaluation may be even more important determinants. This article identifies and synthesizes ecological and biophysical links of mangroves that sustain capture fisheries and aquaculture production. Fish, crustacean and mollusc species associated with mangroves are presented and the ecology of their direct use of this system is reviewed. Through a coastal seascape perspective, biophysical interactions among mangroves, seagrass beds and coral reefs are illustrated. The life-support functions of mangrove ecosystems also set the framework for sustainable aquaculture in these environments. Estimates of the annual market value of capture fisheries supported by mangroves ranges from US\$750 to 16750 per hectare, which illustrates the potential support value of mangroves. The value of mangroves in seafood production would further increase by additional research on subsistence fisheries, biophysical support to other ecosystems, and the mechanisms which sustain aquaculture production.

Author Keywords: Mangroves; Coastal seascape; Ecological services; Capture fisheries; Aquaculture; Economic evaluation

Title: The economic value of wetland services: a Meta analysis

Author: Woodward, R.T. and Y. S. Wui

Source: Ecological Economics, Vol. 37(2):2001, pages 257-270.

Abstract: The number of studies quantify the value of wetlands and the services provided by these ecosystems is rapidly expanding. The time is ripe for an assessment of what has been learned from this literature. Using results from 39 studies, we evaluate the relative

value of different wetland services, the sources of bias in wetland valuation and the returns to scale exhibited in wetland values. While some general trends are beginning to emerge, the prediction of a wetland's value based on previous studies remains highly uncertain and the need for site-specific valuation efforts remains large.

Title: Valuation of wetlands in a landscape and institutional perspective

Author: Soderquist, T., W. J. Mitsch, and R. K. Turner

Source: Ecological Economics, Vol.35 (1): 2000, pages 1-6.

Abstract:

Title: Valuing fisheries depreciation in natural resource accounting: the pelagic fisheries in Northeast peninsular Malaysia

Author: Tai, S.Y., K. M. Noh, N. Mustapha and R. Abdullah

Source: Environmental and Resource Economics, 15(3): 2000, pages 227-241.

Abstract: In this paper, an approach based on the net present value method is used to account for the changes in the value of fisheries resources. Changes in the value of fisheries resources can occur between successive years' catch as well as between current and optimal levels of catch. These changes need to be accounted for in the national accounting system to reflect the 'true' net national income that is sustainable. The approach outlined in this paper is desirable as it allows the estimation of the depreciation value of fisheries resource with limited biological information. The application of the approach to the pelagic fisheries in Northeast Peninsular Malaysia (NEPM) showed that the resource depreciated in value over most years from 1982 to 1993. These depreciations correspond to increased fishing effort. In addition, pelagic catches in NEPM from 1982 to 1993 were lower than the optimal levels of catch due to overfishing. Thus policies aimed at reducing fishing effort can provide improvement in both the potentially higher capital values of the fishery resource and the earning potentials of the fishing industry in NEPM.

Keywords: depreciation, fisheries resource accounting, optimal catch, pelagic fishery, present value

Title: Coastal aquaculture development in Eastern Africa and the Western Indian Ocean: Prospects and problems for food security and local economies

Author: Ronnback, P., I. Bryceson, and N. Kautsky

Source: Ambio, 30(7-8), 2002.

Abstract: This paper reviews the experience and status of coastal aquaculture of seaweeds, mollusks, fish and crustaceans in eastern Africa and the islands of the western Indian Ocean. In many respects, coastal aquaculture is still in its infancy in the region, and there is a pressing need to formulate development strategies aimed at improving the income and assuring the availability of affordable protein to coastal communities. This paper also draws from positive and negative experiences in other parts of the world. The requirements of feed and fry, and the conversion of mangroves are used to illustrate how some aquaculture activities constitute a net loss to global seafood production. The paper presents both general and specific sustainability guidelines based on the acknowledgement of aquaculture as an ecological process. It is concluded that without

clear recognition of its dependence on natural ecosystems, the aquaculture industry is unlikely to develop to its full potential in the region.

Title: Economic Valuation of the Non-use Attributes of a Wetland: A Case Study for Lake Kerkini

Author: Oglethorpe, D. R., D. Miliadou

Source: Journal of Environmental Planning and Management. November - 43(6):2000 pages 755-67.

Abstract: Wetlands are an environmental feature which deliver a variety of market and non-market goods and services. Established environmental economic theory separates the value of these goods and services into direct-use values, indirect-use values and non-use values. Given appreciation of all three, measurements can be derived to demonstrate the amount of public money that it may be feasible to allocate to the sustainable management of wetlands. However, in many cases, non-use values are ignored and the total economic value of wetlands can be severely undervalued. As a result, inadequate resources are fed into their management and environmental degradation occurs due to inappropriate commercial exploitation of the natural resource. Lake Kerkini, in northern Greece, is one such wetland area threatened by undervaluation and overexploitation for commercial purposes, and a resource whose management would benefit from the realization of non-use values. This study therefore uses the contingent valuation method to place a value on the non-use attributes of Lake Kerkini. It also examines the relationship between the revealed non-use values and the distance people live from the lake, highlights the personal characteristics which appear important in determining total willingness to pay and breaks total non-use value down into its component parts to suggest the most important non-use elements. The paper concludes that sustainable management of the lake is justified and provides evidence that substantial public monies are potentially available to protect and enhance the environmental value of the resource.

Title: On the Option Value of Old-Growth Forest

Author: Conrad,-Jon-M

Source: Ecological-Economics, August - 22(2): 1997, pages 97-102.

Abstract: The option value of an old-growth forest is determined when the net value of timber is known and non-timber amenity value evolves according to geometric Brownian motion. The model permits the derivation of a critical barrier or boundary on amenity value, denoted A^* . Specifically, A^* is the minimum amenity value necessary to justify continued preservation. The model is applied to the Headwaters Forest, the last privately-owned stand of old-growth coast redwood, containing timber with a net value between \$500 and \$600 million. Estimates of the mean drift and variance rates for the amenity value of the headwaters are obtained under the assumption that amenity value is proportional to the visitation rate at the Redwood National Park (50 miles north of the Headwaters Forest). For base-case parameters, the amenity value of the Headwaters must exceed \$5.008 million per year to justify continued preservation.

Author Keywords: Headwaters Forest; Minimum amenity value; Preservation

Title: The Value of Biodiversity in Pharmaceutical Research with Differentiated Products

Author: Craft,-Amy-B; R. D. Simpson

Source: Environmental-and-Resource-Economics, January 2001- 18(1): pages 1-17.
Abstract: Biologists and conservation advocates have expressed grave concern over perceived threats to biological diversity. "Biodiversity prospecting" – the search among naturally occurring organisms for new products of agricultural, industrial, and, particularly, pharmaceutical value – has been advanced as both a mechanism and a motive for conserving biological diversity. Economists and others have attempted to estimate the value of biodiversity for use in new pharmaceutical project research. In this paper we apply a new approach to estimating values: we employ two models of competition among differentiated products. Each model confirms previous findings that the value to private researchers of the "marginal species" is likely to be small. The models can have very different implications with respect to social values, however. These findings underscore the need for a better understanding of the true meaning of diversity.
Keywords: biodiversity prospecting, differentiated products, habitat conversion, pharmaceutical research and development

Title: The economic value of forested catchments with timber, water and carbon sequestration benefit

Author: Creedy, J. and A. D. Wurzbacher

Source: Ecological Economics, 38(1), 2001, pages 71-83.

Abstract: This paper examines the optimal management strategy for a forested catchment that yields timber, water and carbon sequestration benefits. The Faustmann multiple rotation model is extended to allow for the maximisation of the net present value of these timber and non-timber benefits. The model is applied to the Thomson Catchment in Central Gippsland, Victoria. Carbon sequestration benefits are modelled via total stand biomass accumulation. The cost of carbon release back into the atmosphere upon logging is estimated as a function of rotation age using an adjusted pulpwood/sawlog ratio. The allowance for both non-timber benefits is found to lengthen the optimal rotation, in a large range of cases to infinity.

Title: The non-use benefits of enhancing forest biodiversity: A contingent ranking study

Author: Garrod, G.D. and K. G. Willis

Source: Ecological Economics, Vol.21 (1): 1997, pages 45-61.

Abstract: Until recently, the majority of commercial forestry in the UK has comprised blanket planting of non-native coniferous species which typically do not offer a high level of biodiversity. However, the UK government, and consequently the UK Forestry Commission, are committed under various international agreements to conserve and enhance biodiversity in British forests. The study reported in this paper estimates that substantial non-use values would be generated if the Forestry Commission were to continue in its current efforts to develop management practices that promote an increase in biodiversity across a large area of its commercial holdings in remote parts of the country which are seldom visited. Rather than adopting a referendum-type contingent valuation method, a discrete-choice contingent ranking approach is used to estimate the general public's willingness to pay to increase the area of these forests managed under each of three forest management standards designed to offer increasing levels of biodiversity at the expense of commercial timber production. This permits relative

preferences for different forest management standards to be measured at the same time as willingness to pay to enhance biodiversity.

Author Keywords: Contingent ranking; Forest biodiversity; United Kingdom; Temperate

Title: Economic Valuation of Special Forest Products: An Assessment of Methodological Shortcoming

Author: Gram, S.

Source: Ecological Economics, January - 36(1): 2001, pages 109-17.

Abstract: The study analyses strengths and weaknesses of different methods for calculating the economic importance of forest products extracted by rural populations. The results show that methods frequently used by scholars are subject to serious uncertainty. The study is based on a 1-year survey in two flood plain villages in the Peruvian Amazon. Different methods were studied in relation to local extraction of timber and non-timber products, including plants, fish and animals. Both products for the market and for subsistence use have been included. A combination of interview methods, observations and notes taken daily by the households was applied.

Author Keywords: Peru; Amazon; Rainforest; Timber; Non-timber; Indigenous peoples; Extraction

Title: A Real Options Approach to the Valuation of a Forestry Investment

Author: Insley, M.

Source: Journal of Environmental Economics and Management, November - 44(3): 2002, pages 471-92

Abstract: The theory of real options is used to model the optimal tree harvesting decision. The value of the option to harvest is estimated using a dynamic programming approach and a general numerical solution technique suitable for any type of stochastic process for prices. The conditions under which the optimal harvest time is independent of price are examined. In addition, the impact of assuming future lumber prices are mean reverting is considered. It is found that option value and optimal cutting time are significantly different under the mean reversion assumption compared to geometric Brownian motion.

Title: Cost-Effectiveness Analysis of Woodland Ecosystem Restoration

Author: Macmillan, C.D., D. Harley, R. Morrison

Source: Ecological Economics, December - 27(3): 1998, pages 313-24

Abstract: Ecosystem restoration has emerged as an important approach to safe-guarding biodiversity. In Scotland, the government is committed to restoring the natural woodland ecosystem of mountain areas and gives payments to landowners for establishing new woodlands. Although the aim of the policy is to restore a natural woodland ecosystem, the rate of payment available is correlated with the costs of establishment rather than the contribution new woodlands make to restoring the natural ecosystem. In this study, the cost-effectiveness of government expenditure is investigated by comparing the cost of grant aid with the ecosystem restoration potential of new woodlands. An expert-based system for scoring ecosystem restoration potential is described and applied to over 200 new woodlands in a Geographic Information System. New woodlands varied considerably with respect to both cost and ecosystem restoration score, with the most cost-effective woodlands established close to existing woodlands using natural

colonisation techniques. Overall ecosystem score was negatively correlated with government expenditure. Alternative approaches to improving the cost-effectiveness of grant aid are discussed.

Author Keywords: Cost-effectiveness analysis; Ecosystem restoration; Biodiversity; GIS

Title: Economic value of the carbon sink services of tropical secondary forests and its management implications

Author: Ramirez, O.A. et. al

Source: Environmental Resource Economics, 21(1): 2002, pages 23-46.

Abstract: This paper explores the economic feasibility of secondary forest regeneration and conservation as an alternative in the campaign addressing the problem of global warming. Detailed measurements of tropical secondary forests over time, in different ecological zones of Costa Rica, are used to evaluate carbon storage models. The paper addresses key issues in the international discussion about cross- and within-country compensation for carbon storage services and illustrates a method to compute/predict their economic value over time under a variety of scenarios. The procedure is applicable to other developing countries where secondary forest growth is increasingly important.

Keywords: activities implemented jointly, carbon sequestration, clean development mechanism, global warming, tropical forests

Title: A Typology for the Classification, Description and Valuation of Ecosystem Functions, Goods and Services

Author: De-Groot, R. S, M. A. Wilson, M. J. Boumans

Source: Ecological-Economics, 41(3): June - 2002, pages 393-408

Abstract: An increasing amount of information is being collected on the ecological and socio-economic value of goods and services provided by natural and semi-natural ecosystems. However, much of this information appears scattered throughout a disciplinary academic literature, unpublished government agency reports, and across the World Wide Web. In addition, data on ecosystem goods and services often appears at incompatible scales of analysis and is classified differently by different authors. In order to make comparative ecological economic analysis possible, a standardized framework for the comprehensive assessment of ecosystem functions, goods and services is needed. In response to this challenge, this paper presents a conceptual framework and typology for describing, classifying and valuing ecosystem functions, goods and services in a clear and consistent manner. In the following analysis, a classification is given for the fullest possible range of 23 ecosystem functions that provide a much larger number of goods and services. In the second part of the paper, a checklist and matrix is provided, linking these ecosystem functions to the main ecological, socio-cultural and economic valuation methods.

Author Keywords: Classification of ecosystem functions; Typology of goods and services; Ecological and socio-economic valuation

Title: Economic and Ecological Concepts for Valuing Ecosystem Services

Author: Faber, S. C., R. Costanza, M. A. Wilson

Source: Ecological-Economics, June 2002, 41(3): pages 375-92

Abstract: The purpose of this special issue is to elucidate concepts of value and methods of valuation that will assist in guiding human decisions vis-à-vis ecosystems. The concept of ecosystem service value can be a useful guide when distinguishing and measuring where trade-offs between society and the rest of nature are possible and where they can be made to enhance human welfare in a sustainable manner. While win-win opportunities for human activities within the environment may exist, they also appear to be increasingly scarce in a 'full' global ecological-economic system. This makes valuation all the more essential for guiding future human activity. This paper provides some history, background, and context for many of the issues addressed by the remaining papers in this special issue. Its purpose is to place both economic and ecological meanings of value, and their respective valuation methods, in a comparative context, highlighting strengths, weakness and addressing questions that arise from their integration.

Author Keywords: Economic valuation; Ecological valuation; Ecological valuation; Ecological services; Valuation

Title: The social value of biodiversity for R&D

Author: Goeschl, T and T. Swanson

Source: Environmental and Resource Economics, 22(4): 2000, pages 477-504.

Abstract: The value of genetic resources for use in research and development (R&D) activities has been the subject of a literature modelling the activity as one where individual firms engage in optimal search. Here we develop a more generalised framework in which genetic resources are used in R&D at the base of an industry that addresses recurring problems of resistance, as in the pharmaceutical or plant breeding industries. The R&D process is one in which firms are engaging in a continuing contest of innovation against a background of both creative destruction (Schumpeterian competition) and adaptive destruction (natural selection and adaptation). This framework demonstrates that the search model is conceptually inadequate because it fails to incorporate the important dynamic characteristics of biological phenomena. We then demonstrate the important differences between firm-based valuation of genetic resources and the social value of genetic resources for use in this contest of innovation. There are six externalities in private patent-based genetic resource valuation, and five of these indicate that private valuations will under-estimate social values.

Keywords: biodiversity, genetic resources, research and development

Title: The Limits to Economic Valuation of Biodiversity

Author: Hampicke,-Ulrich

Source: International-Journal-of-Social-Economics; 26(1-2-3), 1999, pages 158-73.

Abstract: In practice, monetary valuation of biotic resources by the concept of total economic value (TEV) is a powerful tool for a rational treatment of this fraction of natural capital and for its conservation. Beyond methodological limits to monetarisation with regard to its marginal character there are also moral limits. Adopting the weakest and least controversial assumptions regarding both mankind's dependence on biodiversity and environmental ethics, one is led to the conclusion that the impossibility of communicating with future generations forbids us to value biodiversity only in monetary

terms. Fairness towards futurity demands that we consider conservation as a constraint on economic activity.

Title: Accounting for the Value of Ecosystem Service

Author: Howarth, R. B, S. Farber

Source: Ecological-Economics, June - 41(3): 2000, pages 421-29

Abstract: A 'value of ecosystem services' (VES) may be calculated by multiplying a set of ecosystem services by a set of corresponding shadow prices. This paper examines the role of the VES concept in measuring trends in human well-being. Under conventional arguments from applied welfare economics, standard measures of market consumption may be extended to include the value of direct environmental services, which affect welfare in ways that are not mediated by the consumption of purchased goods. The VES concept does not capture values such as ecological sustainability and distributional fairness that are not reducible to individual welfare. And its operationalization is constrained by the well-known limitations of nonmarket valuation methods. Nonetheless, attempts to calculate the value of environmental services can provide insights into the tradeoffs between market activity and environmental quality that are implicit in the process of economic growth. Such efforts can promote informed debate concerning the achievement of sustainable development.

Author Keywords: Ecosystem services; Environmental valuation; Environmental accounting; Sustainable development

Title: The concept of environmental function and its valuation

Author: Hueting, R., L. Reijnders, B. de Boer, J. Lambooy, and H. Janssen

Source: Ecological Economics, Vol. 25(1): 1998, pages 31-35.

Abstract:

Title: The value of the world's ecosystem services and natural capital

Author: Robert Costanza, Ralph d'Arge, Rudolf de Groot, Stephen Farber, Monica Grasso, Bruce Hannon, Karin Limburg, Shahid Naeem, Robert V. O'Neill, Jose Paruelo, Robert G. Raskin, Paul Sutton and Marjan van den Belt

Source: Ecological Economics, Vol. 25(1): 1998, pages 3-15.

Abstract: The services of ecological systems and the natural capital stocks that produce them are critical to the functioning of the Earth's life-support system. They contribute to human welfare, both directly and indirectly, and therefore represent part of the total economic value of the planet. We have estimated the current economic value of 17 ecosystem services for 16 biomes, based on published studies and a few original calculations. For the entire biosphere, the value (most of which is outside the market) is estimated to be in the range of US\$16–54 trillion (10^{12}) per year, with an average of US\$33 trillion per year. Because of the nature of the uncertainties, this must be considered a minimum estimate. Global gross national product total is around US\$18 trillion per year.

Author Keywords: Ecological systems; Capital stocks; Ecosystem services

Title: Integrating Stakeholder Analysis in Non-market Valuation of Environmental Assets

Author: Kontogianni, A., et-al

Source: Ecological-Economics, April 2001,37(1): pages 123-38

Abstract: This study employs a mixed methodological approach, using questionnaire surveys of individuals and stakeholder focus groups to investigate economic values placed on a wetland surrounding Kalloni Bay on the island of Lesbos, Greece. The questionnaire survey of local people and visitors to the area included a rating exercise of four possible development scenarios, and each individual was then asked their willingness to participate in payment for their chosen scenario, and if they were willing to participate, they were then asked a willingness to pay question. Participants were also asked a series of attitudinal questions concerning the local environment and issues relevant to the area. This information was then combined with qualitative information derived from the focus groups, which elicited opinions from important local stakeholders, such as fishermen, elected representatives, constructors and hotel owners about their priorities for both conservation and development. By combining these methodologies, information and conclusions of greater relevance to policy makers can be obtained than using either methodology in isolation.

Author Keywords: Contingent valuation; Environmental values; Stakeholder groups; Mixed methodology; Wetland conservation

Title: Estimating costs of protecting global ecosystem diversity

Author: Lewandrowski, J., R.F. Darwin, M. Tsigas, and A. Ranoses

Source: Ecological Economics, 29(1): 1999, pages 111-125.

Abstract: We estimate the costs to regional economies (as measured by the value of market goods and services forgone) from setting aside land to protect ecosystem diversity. Globally, our framework incorporates 43 unique sets of biological resources. The total annual costs (in 1990 dollars) of retiring 5, 10, and 15% of the world's land area to protect these resources are \$45.5, \$93.3, and \$143.8 billion, respectively. About 45% of global costs occur in Japan and the EC; the US cost share is 15%. Among regional economies, the most impacted sectors are crops, livestock, and forest products.

Author Keywords: Ecological diversity; Biological diversity; Computable general equilibrium model; Geographic information system

Title: Modeling the non-market environmental costs and benefits of biodiversity projects using contingent valuation data

Author: Macmillan, D.C., E.I. Duff and D. Elston

Source: Environmental and Resource Economics, 18 (4): 2001, pages 391-410.

Abstract: CV studies rarely ask willingness to accept (WTA) questions, yet there are a range of environmental projects where there are likely to be potential losers as well as gainers. This paper presents evidence from six biodiversity projects that the inclusion of contingent compensation payments from those respondents who preferred the status quo can substantially reduce net project benefits, even when the proportion of losers is relatively small. A statistical model for estimating the mean welfare measure from dichotomous choice data which allows for both positive WTP, zero WTP, and WTA is described. As many environmental projects are likely to create both gainers and losers,

we recommend that CV analysts give serious consideration to the collection and analysis of WTA data otherwise they risk generating biased estimates of project benefits.

Keywords: biodiversity, CV, non-market costs, willingness to accept, willingness to pay

Title: Pricing Biodiversity

Author: Montgomery, C. A., A. P. Robert, F. Kathrya, and W. Dein

Source: Journal of Environmental Economics and Management, 38:1999, pages 1-19.

Abstract: In this paper, we propose a management price framework to inform decision making directed at the land-management unit level when biodiversity is one of several land-management objectives. The management prices synthesize information about the production relationships that link the public goods aspects of biodiversity to land-management activities. High management prices indicate high marginal returns to conservation effort and, thus, suggest a basis for prioritizing conservation effort. We construct a case study for Monroe County, Pennsylvania, to illustrate the concept of biodiversity management prices, to examine information needs, and to trace out a marginal cost curve for biodiversity.

Title: On the value of a collection of species

Author: Polasky, S. and A.R. Solow

Source: Journal of Environmental Economics and Management, 29: 1995, pages 298-303.

Abstract: One justification for species conservation is the possibility that species will be found to be beneficial. Existing models of the value of a collection of potentially beneficial species typically assume that the probability that each species is beneficial does not depend on the outcome for other species. It is also typically assumed that beneficial species are perfect substitutes. This paper describes a model under which both these assumptions are relaxed.

Title: Economic valuation of the Leuser National Park on Sumatra, Indonesia

Author: Van Beukering, P.J.H., S.J.H. Cesar and M.A. Janssen

Source: Ecological Economics, 44(1), 2003, pages 43-62.

Abstract: The Leuser Ecosystem in Northern Sumatra is officially protected by its status as an Indonesian national park. Nevertheless, it remains under severe threat of deforestation. Rainforest destruction has already caused a decline in ecological functions and services. Besides, it is affecting numerous economic activities in and around the Leuser National Park. The objectives of this study are twofold: firstly, to determine the total economic value (TEV) of the Leuser Ecosystem through a systems dynamic model. And secondly, to evaluate the economic consequences of deforestation versus conservation, disaggregating the economic value for the main stakeholders and regions involved. Using a dynamic simulation model, economic valuation is applied to evaluate the TEV of the Leuser National Park over the period 2000–2030. Three scenarios are considered: 'conservation', 'deforestation' and 'selective use'. The results are presented in terms of (1) the type of benefits, (2) the allocation of these benefits among stakeholders, and (3) the regional distribution of benefits. The economic benefits considered include: water supply, fisheries, flood and drought prevention, agriculture and plantations, hydro-electricity, tourism, biodiversity, carbon sequestration, fire prevention, non-timber forest

products, and timber. The stakeholders include: local community members, the local government, the logging and plantation industry, the national government, and the international community. The regions considered cover the 11 districts involved in the management of the Leuser Ecosystem. With a 4% discount rate, the accumulated TEV for the ecosystem over the 30-year period is: US \$7.0 billion under the 'deforestation scenario', US \$9.5 billion under the 'conservation scenario' and US \$9.1 billion under the 'selective utilisation scenario'. The main contributors in the conservation and selective use scenarios are water supply, flood prevention, tourism and agriculture. Timber revenues play an important role in the deforestation scenario. Compared to deforestation, conservation of the Leuser Ecosystem benefits all categories of stakeholders, except for the elite logging and plantation industry.

Author Keywords: Natural resource valuation; Conservation; Deforestation; Indonesia

Title: Diversity Functions and the Value of Biodiversity

Author: Weikard, H. P.

Source: Land-Economics, February - 78(1):2002, pages 20-27

Abstract: Biodiversity loss has been recognized as one of the most important global environmental problems, but the choice of conservation policies is hampered by the lack of an operational concept of biodiversity. Weitzman (1992, 1998) develops a framework for the measurement of diversity and the identification of cost-effective policies for the preservation of biodiversity. Weitzman's framework has been criticized as being unsuitable for the global problem of biodiversity loss. This paper responds to this critique. It is shown that Weitzman's framework of diversity measurement can be made practical and applicable by shifting the level analysis from species to ecosystems.

Title: Measuring the Total Economic Value of Restoring Ecosystem Services in an Impaired River Basin: Results from a Contingent Valuation Survey

Author: Loomis, John-B., et-al.

Source: Ecological-Economics; 33(1), April 2000, pages 103-17.

Abstract: Five ecosystem services that could be restored along a 45-mile section of the Platte River were described to respondents using a building block approach developed by an interdisciplinary team. These ecosystem services were dilution of wastewater, natural purification of water, erosion control, habitat for fish and wildlife, and recreation. Households were asked a dichotomous choice willingness to pay question regarding purchasing the increase in ecosystem services through a higher water bill. Results from nearly 100 in-person interviews indicate that households would pay an average of \$21 per month or \$252 annually for the additional ecosystem services. Generalizing this to the households living along the river yields a value of \$19 million to \$70 million depending on whether those refusing to be interviewed have a zero value or not. Even the lower bound benefit estimates exceed the high estimate of water leasing costs (\$1.13 million) and conservation reserve program farmland easements costs (\$12.3 million) necessary to produce the increase in ecosystem services.

Title: Comparison of Contingent Valuation and Conjoint Analysis in Ecosystem Management

Author: Stevens,-T.-H., et-al.

Source: Ecological-Economics; 32(1), January 2000, pages 63-74.

Abstract: Contingent valuation (CV) and conjoint analysis were used to estimate landowner's willingness to pay (WTP) for ecosystem management on non-industrial private forest land. The results suggest that even when conjoint and CV questions are the same, except for rating and pricing format, respectively, WTP estimates are quite different. Since most conjoint models essentially count "maybe" responses to valuation questions as "yes" responses, we conclude that conjoint model results often produce WTP estimates that are biased upwards.

Title: Estimating Costs of Protecting Global Ecosystem Diversity

Author: Lewandrowski,-J. et-al.

Source: Ecological-Economics; 29(1), April 1999, pages 111-25.

Abstract: We estimate the costs to regional economies (as measured by the value of market goods and services foregone) from setting aside land to protect ecosystem diversity. Globally, our framework incorporates 43 unique sets of biological resources. The total annual costs (in 1990 dollars) of retiring 5, 10, and 15% of the world's land area to protect these resources are \$45.5, \$93.3, and \$143.8 billion, respectively. About 45% of global costs occur in Japan and the EC; the US cost share is 15%. Among regional economies, the most impacted sectors are crops, livestock, and forest products.

Title: Ecological structure and functions of biodiversity as elements of its Total Economic Value

Author: Fromm, O

Source: Environmental and Resource Economics, 16(3): 2000, pages 303-328.

Abstract: Rational economic decisions regarding the conservation of biodiversity require the consideration of all the benefits generated by this natural resource. Recently a number of categories of values (inherent value, contributory value, indirect value, infrastructure value, primary value) have been developed, especially in the literature of Ecological Economics, which, besides the individual and productive benefits of biodiversity, also include the utilitarian relevance of the ecological structure and functions of biodiversity in the, so-called, total economic value. For the question of including the ecological structure and functions of biodiversity in the total economic value it is of crucial importance to note, that these categories of values are not only terminologically different, but also relate to different ecological levels of biodiversity and – most importantly – to specific complementary relationships – between species, between elements of ecological structures and between ecological functions and their contribution to human well-being. This paper analyses these complementary relationships, discusses their implications for the total economic value of biodiversity and draws conclusions for decision making in environmental policy.

Title: Economic valuation of freshwater ecosystem services in the United States: 1971-1997

Author: Wilson, M. A., and S. R. Carpenter

Source: Ecological Applications, 9 (3), 1999, pages 772-783.

Abstract: The purpose of this paper is to provide ecologists and resource managers with a sense of where the economic science of ecosystem valuation has come from and where it might go in the future. To accomplish this, the paper provides a comprehensive synthesis of peer-reviewed economic data on surface freshwater ecosystems in the United States and examines major accomplishments and gaps in the literature. Economic value has been assigned to nonmarket goods and services provided by surface freshwater systems in the United States by 30 published, refereed articles in the scientific literature from 1971 to 1997. These studies have used variations of three approaches for a quantitative assessment of economic value: travel cost methods, hedonic pricing methods, and contingent valuation methods. To determine the economic value of nonmarket ecosystem goods and services, each method focuses on a different aspect of social benefit associated with lakes, streams, rivers, and wetlands. Valuation methodologies work from different underlying assumptions while possessing unique limitations and uncertainties. Dollar benefit estimates derived for nonmarket freshwater ecosystem goods and services from these studies tend to be specific to a particular method, ecosystem, and socioeconomic circumstance. Creative interdisciplinary research is needed on the quantitative measurement of surface freshwater ecosystem goods and service values, the relation of these values to key limnological variates, and communication of limnological insights to the public and social scientists in ways that facilitate and improve future management and research.

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Abstract: Discusses the ways in which value can be attached to biodiversity and highlights the advantages and disadvantages of different approaches. Introduces biodiversity loss and biodiversity value. Distinguishes between economic and noneconomic value criteria and addresses some of the contrasting value systems being advanced in the global conservation debate. Discusses deliberative and inclusionary procedures for eliciting values. Introduces the concept of time discounting and considers how time preference rates may be altered to account for the specific dilemmas faced by biodiversity conservation. Spells out the economic interpretation of value and outlines the taxonomy of values associated with biodiversity. Discusses the range of economic valuation methods and their limitations, covering economic valuations based on market prices and stated preference methods. Describes the practice of benefits transfer, in which an estimate of willingness to pay from one site, the study site, is "borrowed" and applied to another site, the policy site. Provides policy recommendations.

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