

Science, Service, Stewardship



Ecosystem Services Valuation: An Overview of Methods, Values, and Applications*

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2017 Biennial Forum

La Paz, Baja California, Mexico

March 21-24, 2017

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Valuing ecosystem services

- Increasing recognition of connectivity of nature and society and interest in valuation of ecosystem services
 - 1991 EPA Ecosystem Valuation Forum (Bingham et al. 1995)
 - National Academies of Science panel (NRC 2005)
 - 2009 EPA Science Advisory Board report ([EPA 2009](#))
 - [Natural Capital Project](#) (Stanford, Nature Conservancy, WWF)
 - [Millennium Ecosystem Assessment](#) (MEA)
 - [The Economics of Ecosystems and Biodiversity](#) (TEEB)
 - [Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services](#) (IPBES)
 - [OpenNESS Project](#) (Operationalisation of Natural Capital and Ecosystem Services)

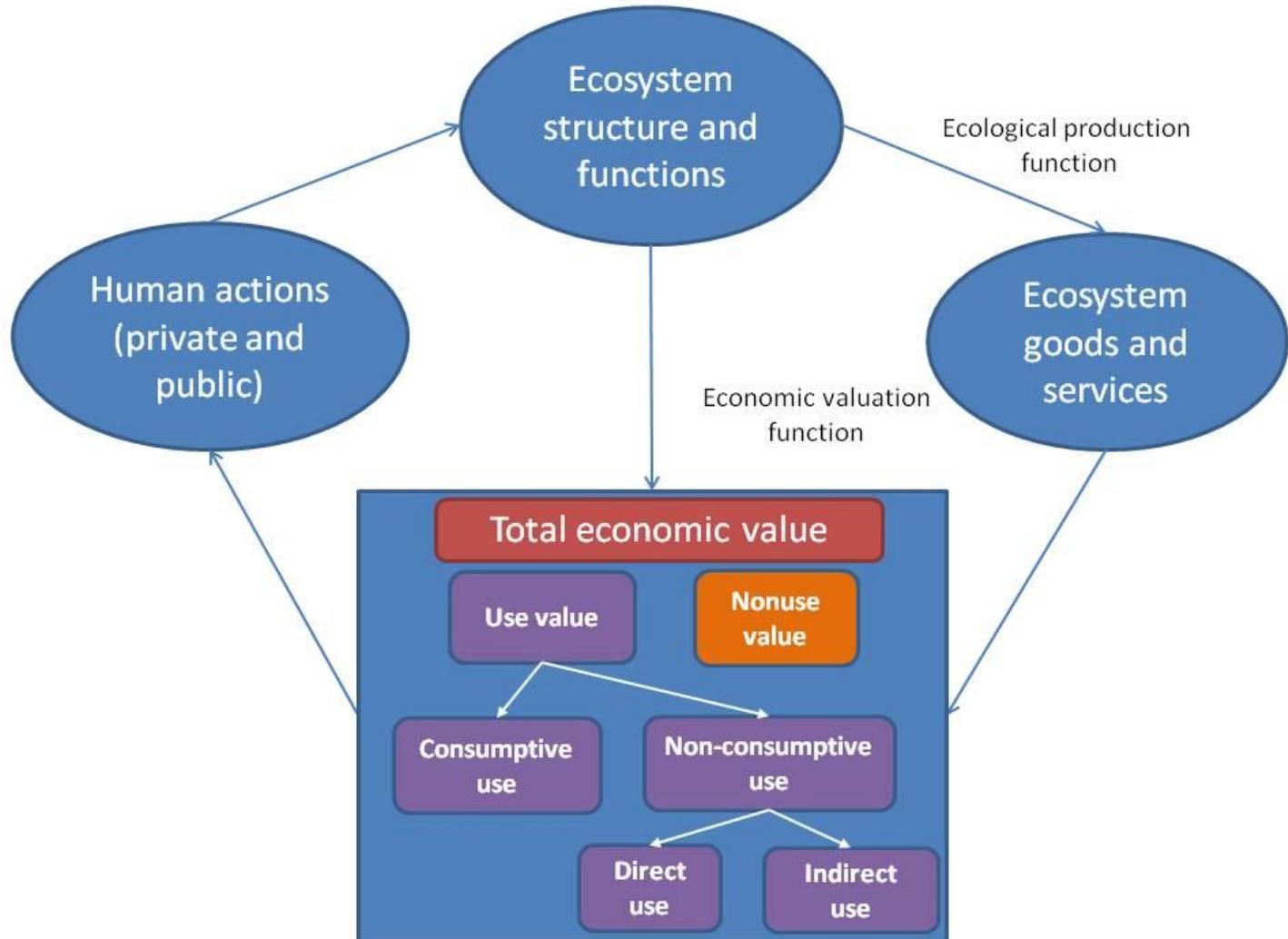


Values for what?

- Ecosystem service values
 - *Ecosystem services* (direct or indirect contributions ecosystems make to the well-being of human populations)
 - *Natural capital* (living and non-living components of ecosystems)



Components of ecosystem valuation





What ecosystem services to value in marine and coastal ecosystems?

Table 1 Various values provided by coastal and marine ecosystems

Use values		Nonuse values
Direct values	Indirect values	Existence and bequest values
Fishing	Nutrient retention and cycling	Cultural heritage
Aquaculture	Flood control	Resources for future generations
Transport	Storm protection	Existence of charismatic species
Wild resources	Habitat for species	Existence of wild places
Water supply	Shoreline stabilization	
Recreation		
Genetic material		
Scientific and educational opportunities		

Sources: Adapted from Barbier (1994) and Heal et al. (2005, Table 2-1).

From: Barbier (2012, REEP)

It depends on the ecosystem...and the policy question(s)!



Methods overview

- Economist toolbox
 - Market valuation methods
 - Ecosystem services traded in markets (e.g., seafood)
 - Non-market valuation methods
 - Revealed preference (RP) approaches
 - Stated preference (SP) approaches





Revealed preference methods

- Measure economic value through related markets
 - Household production function framework – markets for substitutes or complements can be used to measure values for ecosystem services
 - Use values only
- Common types of RP methods
 - Recreation demand (travel cost) models
 - Hedonic pricing models
 - Production function models



Revealed preference methods (cont.)

- Recreation demand models
 - Travel cost proxy for price of recreation
 - Recreation decisions are modeled
 - How many trips and to where? How long are trips?
- Examples
 - Beach recreation (Bin et al. 2005 MRE, Lew and Larson 2008 MRE)
 - Recreational fishing (Lew and Larson 2011, Land Econ, Hynes et al. 2017, Ecol Econ)
 - Recreational diving (Farr et al. 2011, AJARE)



Source: NOAA Photo Library



Revealed preference methods (cont.)

- Hedonic pricing models
 - Use market transaction data and characteristics (including ecosystem services) of market good to estimate hedonic price function
- Examples
 - Submerged aquatic vegetation (Guignet et al. 2017, MRE)
 - Wetlands (Mahan et al. 2000, Land Econ)
 - Coastal beach quality (Landry and Hindsley 2011, Land Econ)
 - Chesapeake Bay water quality (Leggett and Bockstael 2000, JEEM)



Revealed preference methods (cont.)

- Production function methods
 - Assume an ecosystem service is an input in the production of a marketed good
 - Values revealed through changes in the marketed good with changes in ecosystem services
- Examples
 - Ellis and Fisher (1987, JEM) valued loss of spawning habitat in wetlands and mangroves by measuring effects on production and consumption in commercial fisheries
 - Kahn and Kemp (1987, JEEM), Mistiaen, Strand, and Lipton (2003, Estuaries), Kasperski and Wieland (2009, MRE) valued water quality in Chesapeake Bay





Stated preference methods

- Ask questions (usually in a survey) that reveal preferences or values
 - Capable of measuring nonuse values
- Contingent valuation (CV)
 - Respondents are asked (hypothetical market) questions that directly or indirectly reveal their WTP (open-ended, referendum)
 - Examples
 - Beach recreation (Loomis and Santiago 2013, Coastal Mgt) – water clarity
 - Marine wildlife viewing at coral reefs (Farr et al. 2014, Mar Policy)



Stated preference methods (cont.)

- Choice experiments
 - Choose between multiple options that differ in the attributes that describe and differentiate the options
- Examples
 - Beach recreation (Peng and Oleson 2017, MRE; Penn et al. 2016, MRE)
 - Recreational fishing (Anderson and Lee 2013, MRE; Carter and Liese 2012 NAJFM, Lew and Larson 2015, Mar Policy)
 - Endangered species protection (Lew et al. 2010, MRE; Wallmo and Lew 2012, ConBio)
 - Wetland ecosystem services (Petrolia et al. 2013, MRE; Carlsson et al. 2003, Ecol Econ)



Stated preference methods (cont.)

- Contingent behavior questions
 - Respondents asked how their behavior would be different under counterfactual
 - “How many trips would you take [under current /new conditions]?”
- Example
 - Recreational diving in coral reefs (Andersson 2007, Ecol Econ)



Source: NOAA Photo Library



Which ecosystem service values have gotten the most attention?

- Wetland ecosystem services
 - Brander, Brouwer, and Wagtendonk (2013, Ecol Eng): wetland ecosystem services (flood control, water supply) in agricultural landscapes (38 studies selected from 400)
- Recreation values
 - Johnston et al. (2006, MRE): 48 recreational fishing studies between 1977 and 2001 (filtered from 450 studies) analyzed to understand factors affecting recreational fishing values
- Species values
 - Lindhjem and Tuan (2012, EEPS): over 100 studies valuing species and nature conservation in Asia and Oceania



Some practical difficulties in valuing ecosystem services

- Limited understanding of some ecosystems for quantitatively mapping ecosystem structure and function to ecosystem services that can be valued
- Limited public understanding of ecosystem services, and ultimately the contributions to welfare
- Limitations of valuation methods in capturing the role of important underlying ecological relationships (e.g., irreversibilities, dynamics, non-linearities and threshold effects, and interconnections)



Benefits transfer

- Applying existing economic values and value functions to new applications (Johnston and Rosenberger 2010; Navrud and Ready 2007)
- Existing primary studies and values
 - Economic valuation databases: TEEB, Envalue, EVRI, et al. (see <http://www.es-partnership.org/esp/80136/5/0/50>)
- Many challenges to benefits transfer

