
Valuing Ecosystem Services in Natural Resource Damage Assessments

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Perspective

“Not everything that can be counted counts, and not everything that counts can be counted.”

Albert Einstein

Courts have warned against making *“a fetish [of market value] since that may not be the best measure of value in some cases”*

Ohio v. U.S. Department of the Interior 1989

Overview

- What are the new CERCLA revisions?
 - How are ecosystem services valued?
 - What are equivalency methods?
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What are the new CERCLA revisions?

- 2008 CERCLA damage assessment rule revisions for “Type B” procedures
 - Inspired by the Natural Resource Damage Assessment and Restoration (NRDAR) Federal Advisory Committee (convened in 2005)
 - Emphasize resource restoration over economic damages
 - Expands the definition of “compensable value”
 - Includes restoration-based methods
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What are the new CERCLA revisions?

- **Compensable Value**

- The amount of money required to compensate the public for:
 - *The loss in services provided by the injured resources between the time of the discharge or release and the time the resources are fully returned to their baseline conditions, or until the resources are replaced and/or equivalent natural resources are acquired*
 - Included at the discretion of the Authorized Official
 - Two approaches permitted for determining compensable value
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What are the new CERCLA revisions?

- Compensable Value (*cont.*)
 - Economic value approach
 - Consumer surplus of lost services (use and nonuse values)
 - Economic rent of injured resources
 - Government fees for resource use
 - These methods **measure** economic values
 - Travel cost
 - Random utility maximization
 - Contingent valuation
 - Conjoint analysis
 - Others that measure willingness to pay
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What are the new CERCLA revisions?

- Compensable Value (*cont.*)
 - Restoration cost approach
 - Cost to implement projects that restore lost services
 - These methods **scale** restoration projects and then estimate their implementation costs
 - Random utility maximization
 - Conjoint analysis
 - Habitat equivalency analysis
 - Resource equivalency analysis
 - Others that estimate the cost to restore in a cost-effective manner
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What are the new CERCLA revisions?

- Feasibility and reliability of methods
 - Is the method capable of providing useful information for a particular injury?
 - Does the method address the nature, degree, and spatial and temporal extent of the injury?
 - Has the method been peer reviewed?
 - Is the method generally accepted by experts in the field?
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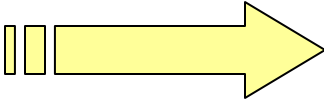
What are the new CERCLA revisions?

- Feasibility and reliability of methods (*cont.*)
 - Is the method subject to standards?
 - Are the method's assumptions and inputs supported?
 - Are cutting edge methods tested or analyzed for reliability?
 - ***All of these factors need not apply in every case***
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How are ecosystem services valued?

- What exactly is valued?
 - Defining this is challenging with ecosystems
 - **Natural resources:** tangible assets provided by nature
 - Air, water, minerals, biota
 - **Functions:** biophysical processes of natural resources that can be assessed independently of the human context
 - Habitat provision, nutrient cycling, photosynthesis
 - **Services:** beneficial outcomes of functions that are appreciated by people
 - Recreation, subsistence, flood control, existence
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How are ecosystem services valued?

- Ecosystem valuation focuses on **services**
 - People understand the beneficial outcomes they appreciate (services)
 - People may not understand the underlying biophysical processes (functions)
 - Functions are necessary but not sufficient for the provision of services
 - To be beneficial, people must also demand the outcomes of functions
 - Preferences
 - Opportunity
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- Landscape Setting

How are ecosystem services valued?

- Types of ecosystem values
 - **Use values:** values derived from physical interaction with ecosystems
 - Examples
 - **Consumptive uses:** values for hunting and fishing
 - **Non-consumptive uses:** values for wildlife viewing and hiking
 - Involve observable behavior
 - Current or future use
 - On or off-site use
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How are ecosystem services valued?

- Types of ecosystem values (*cont.*)
 - **Non-use values:** values derived independently from physical interaction with ecosystems
 - Value of knowing ecosystems exist or will be preserved in a given condition
 - Motivations include bequest, altruism, and ethics
 - Courts have recognized non-use values as potentially valid components of damage assessment awards (*Ohio v. DOI 1989*)
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How are ecosystem services valued?

- Fundamental economic approach
 - Assign economic values according to the ability of resources to satisfy human needs
 - Anthropocentrism without apology!
 - Key determinants of economic value
 - **Preferences:** resources provide services that people demand and appreciate to various degrees
 - **Scarcity:** abundant resources are better able to provide services than scarce resources
 - Economic valuation of ecosystems follows this fundamental approach
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How are ecosystem services valued?

- Economic valuation methods
 - ***Revealed preference methods:*** observe people making binding choices regarding real alternatives
 - Cannot estimate non-use values
 - Cannot value un-experienced scenarios
 - ***Stated preference methods:*** observe people making non-binding choices regarding constructed alternatives
 - Can estimate non-use values
 - Can value un-experienced scenarios
 - Concern about “hypothetical bias”
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How are ecosystem services valued?

- National Park Service database of values
 - Value ranges by activity (1996 \$ per visitor day)
 - Backpacking \$22.35 - \$66.95 (1 study)
 - Bird watching \$4.83 - \$65.38 (4 studies)
 - Fishing \$1.73 - \$464.02 (129 studies)
 - Hiking \$0.33 - \$218.37 (21 studies)
 - Mountain biking \$17.38 - \$246.41 (7 studies)
 - Picnicking \$7.45 - \$118.95 (8 studies)
 - Rock climbing \$22.18 - \$113.18 (4 studies)
 - Swimming \$1.83 - \$111.95 (11 studies)
 - Wildlife viewing \$2.00 - \$289.90 (69 studies)
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How are ecosystem services valued?

- Suggested references

- <http://www.ecosystemvaluation.org>
 - Kopp, R.J., and V.K. Smith, editors. Valuing Natural Assets: The Economics of Natural Resource Damage Assessment. Resources for the Future 1993.
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What are equivalency methods?

- Habitat Equivalency Analysis (HEA)
 - Determines the amount of restoration required to offset ecosystem losses
 - First developed for CWA § 404 permitting
 - Commonly used in natural resource damage assessments
 - Applied to ecological risk assessment consequence analyses
 - **Does not** measure ecosystem attributes
 - **Does not** measure economic values
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What are equivalency methods?

- HEA determines the amount of restoration such that...
 - Sum of replacement services = Sum of lost services
 - Services quantified in units such as **acre-years**
 - One acre-year represents the ecosystem services provided by 1 acre of habitat for 1 year
 - Captures **space** and **time** dimensions of service provision
 - Quantification is specific to habitat and landscape settings
 - Accounts for the time preferences of people through **discounting**
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What are equivalency methods?

- HEA assumes that the unit values of lost and replacement services are ***equal and constant***
 - Given that...

Sum of replacement services = ***Sum*** of lost services

implies

Value of replacement services = ***Value*** of lost services

and

The concept of ***compensation*** is satisfied

What are equivalency methods?

- This assumption also implies *in-kind* replacement of lost services
 - Similar services reasonably have similar values
 - Habitat setting
 - Landscape setting
 - Appropriate restoration opportunities must exist
 - Lost and replacement services must be quantified by a common metric (e.g., percent cover of an indicator plant species)
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What are equivalency methods?

- Example
 - Injury of a 10-acre wetland
 - Must specify a time path of loss
 - 100% lost services from 2008 to 2013
 - Decreasing to 80% lost services by 2018
 - Remaining at 80% lost services into perpetuity
 - Indicated total lost services = 289.08 acre-years
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What are equivalency methods?

- Example (*cont.*)
 - Restoration of a degraded wetland of similar habitat and landscape settings
 - Must specify a time path of replacement
 - 0% replacement services in 2010
 - Increasing to 70% replacement services by 2020
 - Remaining at 70% replacement services into perpetuity
 - Indicated rate of replacement = 19.324 acre-years of replacement services per acre of restoration
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What are equivalency methods?

- Example (*cont.*)
 - Calculation of the amount of required restoration

$$289.08 \text{ acre-years} \div 19.324 \text{ acre-years/acre} = 14.96 \text{ acres}$$

This compensatory restoration requirement can be monetized by estimating implementation and maintenance costs

What are equivalency methods?

- Suggested references

- King, D.M., and K.J. Adler. “Scientifically Defensible Compensation Ratios for Wetland Mitigation.” Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency, January 1991.
 - Allen, P.D., II, D.J. Chapman, and D. Lane. “Scaling Environmental Restoration to Offset Injury Using Habitat Equivalency Analysis.” In Economics and Ecological Risk Assessment, edited by R.J.F. Bruins and M.T. Heberling. CRC Press, 2005.
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